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Shock Treatment

ONE more fighter; no more bombers. The decree sent a shock through the land like a low-level supersonic cross-country by a P.1. But while shock treatment is generally considered to straighten out the mind, it is clear that public thinking on defence is more tortuous than before. We ourselves sought to make some clinical contribution last week by pointing out that lack of a supersonic bomber might not prove so serious after all; and we now offer a simple prescription for dispelling illusions in respect of fighters and missiles.

First, let it be understood that years must elapse before an effective ground-to-air missile system can be set up for the defence of the United Kingdom. Once this truth succeeds in penetrating, the public may realize that they must go on living with manned combat aeroplanes, flown by genuine non-redundant, fighting-type pilots, for years to come; and their thoughts may veer from magical mushroomings of missile sites towards tangible flesh, blood and hardware. Then they may enquire what manner of fighter will be defending them; and they will find a large part of the answer in this issue (pages 541-545). Simply stated, the P.1 is comparable, in all aspects of performance, with the best of America's Century series. Allied with Mach-2-plus potentiality it has exceptional manœuvrability at all levels; it displays uncommon possibilities in the matter of armament; and though a single-seater, it has all-weather capability.

But several score, or even a few hundred, P.1s will not constitute the whole fighter sum. Too often is it forgotten that production of early marks of the Gloster Javelin was slackened off some months ago so that later versions could be advanced in the time scale; and Javelin 7s should shortly be reaching the Service. Though not having level supersonic speed, they will achieve long endurance and a lofty ceiling and will have impressive armament and electronics capacity.

If these fighter facts are accepted, a persistent, mild missile-fixation will not be an unhealthy sign—provided that the missiles are those intended to multiply the killing power of the fighters.

Transistor Art—or Artifice?

A LITTLE operational experience of transistors in airborne equipment has now been accumulated, and some operators may soon be in a position to evaluate the claims of the various American manufacturers who have so ardently publicized the merits of these new electronic devices.

In performing the task of the traditional thermionic valve, the transistor offers several very important advantages. It requires low power supplies, generates little heat, and is very small. In aircraft applications these three characteristics are of the greatest importance, because power supply, cooling resources, space and weight-lifting ability are now being strained to the limit. On the other hand, the germanium crystal transistors now in use have certain critical shortcomings. It is difficult to give them uniform characteristics; they do not readily handle high frequencies; and cannot stand up to high temperatures. The greatest difficulty is that of manufacture: only extremely long production runs, such as those for domestic appliances, can give any reasonable return without excessively high rejection-rates. Aeronautical equipment does not require such mass-production.

Transistors, then, have a limited application at the moment, and they are certainly not capable of replacing all valves in even a medium-wave airborne radio receiver with sure promise of reliable performance. The reliability of such transistors as have been put into operation—in fuel-gauge systems, cabin public-address apparatus or intercom equipment, for example—is to some extent an unknown quantity; so far, it shows no signs of being better than that of valves.

Development of many kinds of transistor is proceeding at full speed on both sides of the Atlantic; but the standards of reliability and producibility implied in the typical high-powered publicity of the New World have yet to be attained.

FROM ALL QUARTERS

Hawker Siddeley - Brush Merger?

A SHARE offer by the Hawker Siddeley Group, Ltd., for the whole of the capital of the Brush Group of engineering firms was announced on April 18. This proposed merger depends for completion on the approval of Brush shareholders.

Sir Roy Dobson, Hawker Siddeley director, said his group were "vitally concerned in the development of nuclear energy" and that by merging their resources with Brush they could take a further big step in this field.

Among Brush Group subsidiaries are Brush Electrical Engineering; Mirlees, Bickerton and Day; National Gas and Oil Engine Co.; and Petters, Ltd.

Shackleton Trainers

REFERENCE may now be made to the Avro Shackleton T.4. This navigational trainer for Coastal Command is a conversion of the Mk 1 maritime reconnaissance aircraft, a type which is being replaced in squadrons by the M.R.2 and 3. Avro are converting the M.R.1s into T.4s at Langar, Notts; the trainer is almost unchanged in external appearance, apart from the addition of extra aerials.

The R.A.F.'s Defence Rôle

SPEAKING in the debate on the Defence White Paper last week the Minister of Defence, Mr. Duncan Sandys, said that our V-bombers and "further developments of which they are capable" would be "highly effective" for some years to come. They would be progressively supplemented by American ballistic rockets, which would be subject to certain restrictions; but in the meantime the British V-bombers with British nuclear bombs would "give us a far from negligible element of nuclear deterrent power under our own control."

Mr. Sandys stressed that as far as the future of the R.A.F. was concerned the changeover to new weapons would be "a gradual process, extending over a good number of years." Of the rôle of Transport Command he said that the Government attached great importance to the mobility of "a strong central reserve of troops in Britain" and for this purpose "such further Britannias as may be necessary" would be ordered.

Later, the Minister of Labour, Mr. Iain Macleod, said he estimated there would be a reduction of "some 15,000" workers in the aircraft industry during the next twelve months as a result of defence cuts.

Two New Russian Rotorplanes

WORK has been under way on a "cheap and economical" helicopter project by W. Winicki, a Soviet engineer. Powered by a 260 h.p. AI-14, the design would have a 36ft three-blade main rotor and would weigh 1,785 lb empty and 2,865 lb loaded. Maximum speed is given as 93 m.p.h., cruising at 71 m.p.h., range 215 miles, hovering ceiling 3,280ft and absolute ceiling (two up) as 13,780ft.

Kamov, whose Ka-15 was illustrated in our January 4 issue, has evolved this machine into the Ka-18 four-seater. Already in bulk production, the Ka-18 is being assigned to local administrative bodies for multiple rôles. The two-seat Ka-15 is being used by collective farms, fishing vessels and as a bush-patrol helicopter.

SMALLEST AND LIGHTEST helicopter yet flown by man is this newest version of the Pinwheel, seen in flight at Glendale, California. Unusual in a helicopter is the retractable undercarriage (the pilot's).

FLYING BOXCAR is the Russian popular name for this impressive Yak-24 twin-rotor helicopter (Allied code-name "Horse"). The power units are two 14-cylinder ASh-82V air-cooled radials, each delivering over 1,400 h.p., and a useful load as high as 10,000 lb appears to be possible. A notable feature is a rear-loading ramp for vehicles, guns or bulky freight. Typical passenger accommodation is 40.

Orpheus-Lockheed

WHEN Lockheed Aircraft, of Burbank, Cal, recently announced that their Model GL-135 light executive transport would fly in September many observers expressed surprise at the tight schedule. It is now possible to explain part of the rapid progress by repeating a recent statement by *American Aviation Daily* that the engines will be Bristol Orpheus. Possibly a production GL-135 would use two "civil" BOr.4s licence-built by Curtiss-Wright.

In an alternative version four General Electric J85s would be used, similarly mounted on the rear fuselage sides. Production may be assigned to the Marietta plant of the firm's Georgia Division.

Missiles for NATO

IT has been announced in Paris that three types of American missile will be supplied to "certain NATO nations" under the U.S. Mutual Aid Programme for 1957. They are Honest John, Matador and Nike. Simultaneously it was stated that "certain other types of advanced defensive weapons" would be supplied. U.S. law forbids either transfer or sale by the United States of nuclear components for weapons.

Ryan X-13 Flies—and Converts

THE U.S.A.F. has announced that its Ryan X-13 "Vertijet" V.T.O. research aircraft has taken off vertically and has flown horizontally, "marking a new technical break-through in aeronautical science". The test was conducted at Edwards Air Force Base, California.

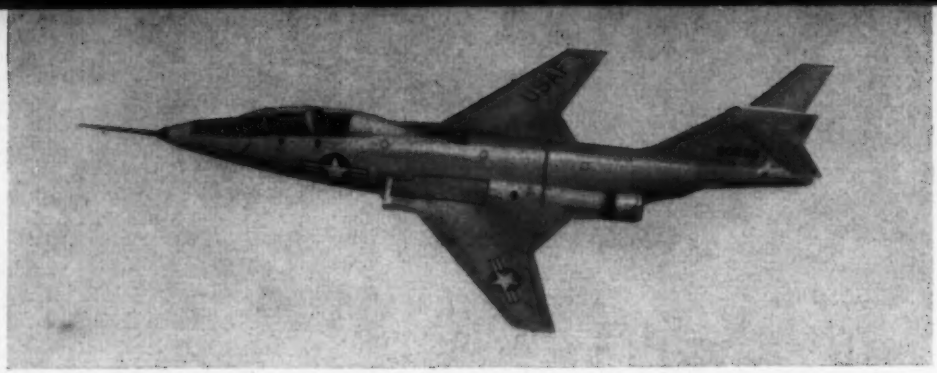
Little is known of the X-13 except that it is of delta configuration; that it is a tail-sitter; and that it is powered with a British-built Rolls-Royce Avon turbojet. Control jets are probably mounted in fairings at the wing-tips, and possibly at the tips of the vertical tail surfaces.

Holland's All-weather Fighters

IT was alleged recently in the Dutch House of Representatives that the 56 F-86K all-weather fighters allocated to the R.N.A.F. under M.D.A.P. spent too much time on the ground, were too complicated for the single occupant to handle in the air and that the electronic fire-control was too complex to maintain. Only 16 of the 56 machines, it was said, were serviceable at any one time and maintenance was severely handicapped by lack of spares, technical equipment and trained groundcrew.

Originally the Dutch Government was to have purchased 28 F-86Ks, a further 28 being given under M.D.A.P. But later all 56 F-86Ks were supplied free under M.D.A.P. and the money originally allocated for purchase was diverted to buy 48 additional Hawker Hunters. It had been generally expected that two-seat

NEXT WEEK: "Flight" Civil Aviation Number: World's Airlines



VOODOO B: This McDonnell F-101B Voodoo —a two-seat long-range intercepter development of the single-seat F-101A —is now on test.

all-weather fighters would be bought, and the training of radar observers had already started.

In reply to these allegations the Dutch Minister for War said that the poor serviceability of the F-86Ks was caused simply by lack of spares. The aircraft had been delivered much earlier than the necessary ground equipment and spares, but the American Government was doing its best to improve this situation. The Minister denied that the aircraft were unsuited to their special task. They had been, he said, the only aircraft for that rôle available at short notice.

But a degree of controversy still persists and, during a recent visit to Convair at San Diego, Prince Bernhard stated that the Dutch Government was interested in acquiring F-102s. His Royal Highness flew in a TF-102A.

Cossor Radar Tour

KNOWN as C.R.21 and produced by Cossor Radar and Electronics, Ltd., a new mobile, high-power, surveillance radar has just left England for a demonstration tour of Scandinavia and Western Europe. A prototype of the equipment was on view at the last Farnborough Show, and the set which is touring Scandinavia and Western Europe will eventually be on exhibition at the Paris Show (May 24-June 2).

The makers state that the new radar, designed primarily for air-traffic control, can be used either in mobile form or as a fixed installation. It is able to "see" through rain and snow, and to eliminate unwanted permanent echoes from mountains or buildings.

New Cranfield Professorship

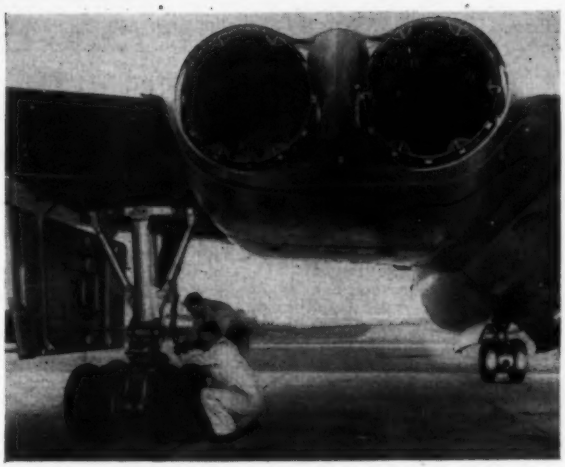
THE governors of the College of Aeronautics, Cranfield, announce that Dr. Alfred James Kennedy, A.M.I.E.E., F.Inst.P., has accepted appointment as the first Professor of Materials and Metallurgy, and will take up his duties at the College on May 1. Dr. Kennedy is at present Head of the Metal Physics Section of the British Iron and Steel Research Association.

The new professorship has been created "in view of the increasing importance of materials and metallurgy in the aircraft industry and in aeronautical research". The section dealing with this subject already has as its primary teaching function the introduction of post-graduate students in their first year to the science of materials and the techniques by which that science is applied in modern aeronautical development. The section also provides advanced lecture and laboratory facilities for students whose thesis work involves research into the uses and properties of materials.

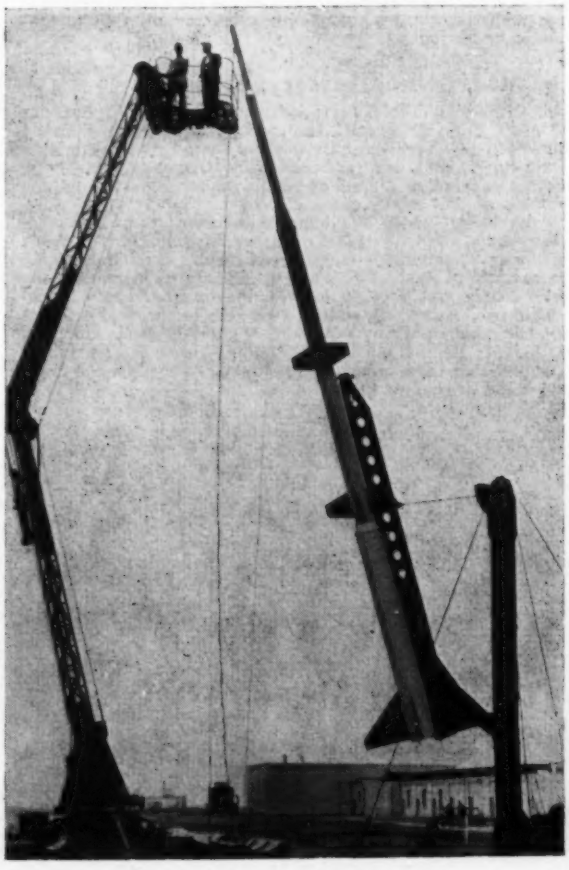
From Wheels to Wings

THE livery dinner of the Worshipful Company of Coach Makers and Coach Harness Makers was held on April 15 at Mansion House, London, by permission of the Lord Mayor. Among the members of this venerable organization are many representatives of the motor and aircraft industries which have now largely supplanted the original coach-and-harness-making industry, and a number of them were present at the dinner. Sir Cullum Welch, the Lord Mayor, was guest of honour and Lord Kenilworth, the Master of the Company, presided.

After Mr. R. J. D. Smith, the Senior Warden and Clerk, had proposed the health of the Lord Mayor and he in his turn had replied, the toast of "The Company" was proposed by Viscount Monckton of Brenchley. He traced its history through many years of work, recalling that several of his forebears had been its masters. Replying to the toast, Lord Kenilworth welcomed the guests, who included the French and Cuban Ambassadors and representatives of several of the other livery companies. The evening was rounded off by a reply on behalf of the guests from the Cuban ambassador, Señor Roberto Mendoza, which for lucidity and delivery left nothing to be desired.



ELECTRO-HYDRAULICS service engineers inspecting the undercarriage of a Handley Page Victor at Radlett. The picture is also a study in the installation of the Armstrong Siddeley Sapphires.



OVER 6,860 m.p.h. was attained by the five-stage research vehicle (right) recently fired at the N.A.C.A. Wallops Island base. Honest John and Nike boost-motors lifted the vehicle to the peak altitude, after which a second Nike, a Recruit and a T-55 were fired.

GREYHOUND TANKERS: Three Boeing KC-135s just off the line at Renton. This type will be the standard U.S.A.F. high-speed tanker.

FROM ALL QUARTERS . . .

Bristol Turbojets by Wright

LAST week Bristol Aero-Engines and Curtiss-Wright announced the conclusion of an agreement under the terms of which certain Bristol gas-turbine aero engines will be built by the Wright Aeronautical Division of the latter company.

One of the engines is a commercial turbojet, of which Mr. Roy T. Hurley, chairman and president of Curtiss-Wright, said: "This is an engine which provides the necessary thrust for planned jet transport aircraft for all-weather operation out of present commercial airport facilities. The design gives lower noise-levels than current jet transport engines. The engine offers superior performance to that of competing jet engines in the critical areas of fuel consumption, thrust and weight. At the same time turbine operating temperatures are substantially lower, offering a marked improvement in reliability, safety and maintenance costs. It is planned to demonstrate the potentialities of this engine in the U.S.A. in the near future."

Wright are already interested in the various advanced models of the Olympus, and the new agreement may well involve such units as the Orpheus and Orion. The new turbojet referred to by Mr. Hurley may be the B.E.47, a 6,000 lb-thrust engine of which nothing official, but much unofficial, has been said. Alternatively, it could be the much larger Olympus 510-series.

The R.A.F. Anniversary Concert

COMMEMORATING the foundation of the Royal Air Force in April 1918, the R.A.F. Anniversary Concert was given on April 13 in the Royal Albert Hall. Only a year after the formation of the Royal Air Force itself the R.A.F. Benevolent Fund came into being, and it was in aid of this very deserving cause that the performance was organized.

The concert—which it is hoped will become an annual event—was being given for the second successive year. Last year's inaugural performance was honoured by the attendance of the Queen and the Duke of Edinburgh. Though no member of the Royal Family was present this year the occasion was a distinguished one. Among the audience were the Secretary of State for Air, Mr. George Ward; the Chief of the Air Staff, Air Chief Marshal Sir Dermot Boyle; and the Lord Mayor of London, Sir Cullum Welch. Also present was Viscount Knollys, council chairman of the Benevolent Fund.

Taking part in the programme were the Hallé Orchestra (leader, Laurance Turner), under Sir John Barbirolli; the Central Band of the R.A.F., conducted by W/C. A. E. Sims; the Alexandra Choir; the Board of Trade Choir; and members of other Civil Service choirs. Constance Shacklock, the operatic mezzo-soprano, was the soloist; and the programme was introduced, and the various items announced, by film actor Kenneth More.

Though competent enough in execution if undistinguished in content, the first part of the programme evoked little more than routine applause until its two final items, when, under the baton of Charles Proctor, the choirs, orchestra and organist (Eric Chadwick) filled the great auditorium with the *Easter Hymn* from *Cavalleria Rusticana* and then with the *Hallelujah Chorus*.

Leading off with the ever-fresh *Dam Busters*, conducted by its composer, Eric Coates, the second half was of a more spectacular nature, to which the audience at once responded, clearly aided by the colourful personality of Sir John Barbirolli, who had now stepped on the rostrum. In an unannounced item by the R.A.F. Band, the *Old Comrades* march, it was Sir John who unexpectedly conducted. "He seldom has the opportunity of conducting a real military band," said Kenneth More; and it certainly looked as though the small, dynamic figure was thoroughly enjoying the experience. Later there was laughter when Sir John, having started to conduct the *Royal Air Force March Past*, handed his baton to W/C. Sims after a few bars, stepped down and took over a cello—on which instrument he was once an infant prodigy.

An impressive rendering of *Land of Hope and Glory*, by band, orchestra, organist, soloist, choirs and—finally—audience, brought the performance to a close.

U.S. Engines Inquiry

A SPECIAL Armed Services investigating sub-committee of the U.S. House of Representatives is to conduct an investigation into the aircraft engine industry which according to its chairman, Edward Hebert, would save the Government "a tremendous sum of money." He said the sub-committee's investigation of airframes during 1955 and 1956 had enabled the Government "to recover 328m dollars from the aircraft industry" and the study of aircraft engine procurement "should be almost as productive."

Mr. Hebert said that the sub-committee wanted answers to three main questions: (1) Are the Navy and Air Force being charged an excessive amount of money; in other words, are the manufacturers reaping excessive profits? (2) Can greater economies be obtained in the purchase of engines? (3) Are the contracts for the procurement of these engines adequate and suitable to protect the best interests of the Government?

He added that questionnaires had been sent to 15 major aircraft engine manufacturers and two companies—Buick Motors and Chevrolet—which until recently manufactured such engines. They had been asked to return the questionnaires by May 13 so that public hearings could begin in June.

This is, we believe, the first time that re-negotiation (as it is termed) has been applied to engines. An established American procedure in the case of airframes. it means in effect that the Government reviews a firm's costs after a particular type has been in production for, say, two or three years. If the figures are found to be substantially lower than first estimates had suggested, then the constructor may be called upon to refund a considerable proportion of the difference.

THIRD VARIANT of the Saab-32 Lansen for the Royal Swedish Air Force will be the "C" reconnaissance sub-type. Recognizable is a slightly modified nose, and internal provision is made for several different cameras and "complete electronic equipment for night navigation and radar reconnaissance." The type will succeed the present S.18 and S.29, also manufactured by Saab.

Above is the Lycoming T53 in an adapted HOK helicopter (prototype of the K-600-3). At right, the same aircraft demonstrates the use of its cargo hook. Rear clamshell doors ensure easy loading and unloading.

America Buys Blackburn Turmos

British Turbines for Kaman Helicopter

TWO Blackburn Turmo 600 shaft turbines have been procured by the Kaman Aircraft Corporation, of Bloomfield, Connecticut. In announcing this, the makers of the aircraft state that a version of their K-600 helicopter, adapted for the Franco-British powerplant and known as the K-600-4, is to be evaluated by the Canadian military Services. Coupling of the Turmos will be undertaken by Kaman.

The K-600-4 is a straightforward adaptation of the K-600-3, powered with the Lycoming T53 gas turbine. The Lycoming version has already completed over 80 hours of operating time, including 50 hours of tethered testing and more than 30 hours in the air. Speeds higher than 115 kt and heights of over 5,000ft have been attained. Installation of the turbine in place of the Pratt and Whitney R-1340 piston engine has conferred greatly increased cabin area, higher performance and a wider range of applications without increase in overall dimensions. The makers state that operation is simpler by virtue of a turbine governor, which automatically supplies the right amount of power as demanded by the pilot through his pitch-stick setting and maintains rotor r.p.m. at a constant, pre-selected speed. The standard HOK structure, rotor system and transmission system have been retained.

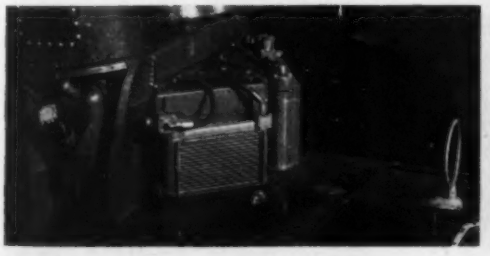
Commenting on the acquisition of the new Blackburn engines the makers state: "The twin Turmo K-600-4 provides twin-engined operation, which in turn provides increased operational safety and the unusual opportunity of operating cruise portions of flight on one engine, thereby substantially increasing ranges and endurance. The Turmo 600 gas turbine has completed its 150-hour Air Registration Board Certification tests in England and is a fully certificated engine in quantity production. Two of the Turmo 600 engines are presently at Kaman Aircraft's Bloomfield, Connecticut, plant undergoing preliminary test and evaluation. Company officials believe that the twin Turmo-powered K-600-4 will be of great interest to the commercial helicopter operator. Analysis indicates the twin Turmo version will operate at a lower hourly operating rate than existing helicopters. Ton-mile and seat-mile rates are expected to be lower. . . . Kaman Aircraft plans to undertake C.A.A. Certification of either the T53-powered version or the twin Turmo version as commercial interest develops."

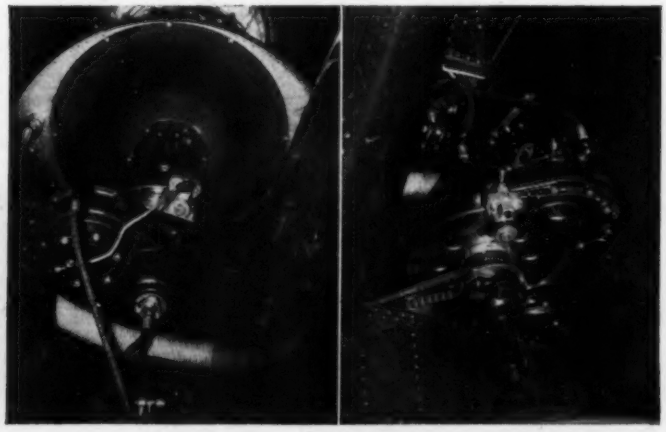
KAMAN K-600-4
(Coupled Turmo 600)

		2-seater	5-seater	3,000 lb cargo
Weights				
Useful Load (lb)		1,800	2,340	3,770
Crew (lb)		(200)	(200)	(200)
Passengers (lb)		(200)	(740)	—
Cargo (lb)		—	—	3,000
Fuel (lb)		(1,300)	(1,300)	(470)
Misc. useful (lb)		(100)	(100)	(100)
Empty Weight (lb)		3,955	3,955	3,955
Gross Weight (lb)		5,755	6,295	7,725
Performance				
Vertical rate of climb (ft/min) at s.l.	A	960	460	—
	B	1,810	1,360	140
Absolute hovering ceiling (ft)	A	15,200	12,000	—
	B	18,000	15,200	4,000
Max. rate of climb (ft/min) at s.l.	A	1,350	1,130	600
	B	1,986	1,670	960
Service ceiling (100 ft/min)		23,200	20,600	12,700
Speed at s.l. (kt)		101	99.3	95
Speed at altitude (kt)		106 (8,000ft)	103 (6,000ft)	95 (s.l.)
Range (n.m.) at s.l.	C	177	172	66
	D	200	193	54
Cruising speed (kt)	C	92	91	86
	D	80	77	60
Endurance (hr) at s.l.	C	2.47	2.34	.764
	D	3.52	3.25	1.0
Cruising speed (kt)	C	43	44	51
	D	43	44	51

Note: For the purpose of the above assessment Kaman assume that the twin Turmo (normal rating 800 h.p.; military rating 900 h.p.) would have a normal power of 600 h.p. and a military power of 720 h.p. Under the "Performance" heading A = 600 h.p.; B = 720 h.p.; C = two-engine operation; D = single-engine operation.

Below is a view of the T53 oil-cooler installation, with fairing and oil-tank cover-panels removed. The coolers are mounted above the cabin, forward of the rotor pylons. Immediately on the right is a view looking aft between the pylons, towards the powerplant. The remaining view shows the "transmission adaptor," which provides the proper speed ratio between the T53 and the standard HOK-1 transmission.





TAKING OVER a new Miles Aries at Shoreham is Mr. Vivian Varcoe, Shell-Mex and B.P. aviation sales manager. Mr. F. G. Miles (right) is handing over the log-book; behind is Mr. Ian Forbes, sales manager of F. G. Miles, Ltd., and on the left is Mr. J. W. P. Angell, a director. The Aries replaces a Messenger used by Mr. Varcoe since 1947.

TAKING ALONG an S-51 to the packing depot of R. and J. Park, Ltd., for shipment to Canada. The aircraft—which had been flown to the Chiswick Polytechnic Sports Ground from Croydon, is one of three which Autair, Ltd., is despatching to its Canadian associate for a long-term defence contract for airlifting of men and equipment.

HERE AND THERE

Pilgrimage Air Umbrella

A WATCH is being kept by aircraft of R.A.F. Coastal Command on *Mayflower II*, replica of the vessel which carried the Pilgrim Fathers, during her voyage across the Atlantic which began last Saturday.

American Shop Window

AMONG British firms which have been exhibiting at the United States World Trade Fair, held in the New York Coliseum, are the Bristol Aeroplane Co., the de Havilland Aircraft Co. and Vickers-Armstrongs (Aircraft).

U.S.A.F. Deterrent Power

AT San Antonio, Texas, recently the newly appointed Chief of Staff of the U.S.A.F., Gen. Thomas White, said the Air Force could now deliver "more destructive force on more targets at greater distance more quickly and accurately than ever before." He added that 1,400 B-47s were now in service throughout the world.

U.S. Changes of Command

IT was recently announced that Brig-Gen. J. Stanley Holtoner is to succeed Brig-Gen. James F. Whisenand as deputy commander of the U.S. Third Air Force, with headquarters at South Ruislip, Middx. Gen. Holtoner, who is 45, has commanded the Air Force Flight Test Center at Edwards A.F.B., Muroc, California, since February 1952. It was also announced that Maj-Gen. Brooke Allen, U.S.A.F., is to succeed Maj-Gen. A. Grussendorf, U.S.A.F., as commander of the Sixth Tactical Air Force under SHAPE.

CENTURY: First woman member of the West London Aero Club, White Waltham, to complete 100 hours' solo flying within a year is Miss Mary Handley Page, daughter of Sir Frederick Handley Page.

I.o.W. Rocket Warnings

DETAILS of warning signals to be shown when rocket-testing is in progress from the Saunders-Roe site near the Needles, I.o.W., were announced recently. A red flag will indicate a test-firing within two hours and a yellow flag flown beneath the red one means that firing is imminent.

Sweptback Undercarriage

WHILE an airliner with 39 people aboard circled the airport at Lubbock, Texas, recently for three-quarters of an hour with undercarriage trouble, members of the crew broke a window and (it is reported) used a broomstick to "jiggle the landing-gear mechanism" until the wheels were safely locked down.

Another U-2 Lost

FOUR days after a Lockheed U-2 had taken off from an airfield in Nevada and disappeared, its wreckage was found by a Civil Air Patrol aircraft in remote desert in eastern Nevada. The U.S.A.F.—according to a New York report—asked local authorities "to post a maximum security guard on the wreckage because it contained some secret information."

R.Ae.C. Competition Dates

REVISED dates and locations for the Royal Aero Club aerobatic and racing events due to have been held at Yeadon on June 10 (referred to in a news item on p. 503 last week) have been announced. The Aerobatic Trophy competition is being flown at White Waltham on June 10; and all three rounds of the National Air Races, and the King's Cup Air Race, at Baginton on July 12 and 13.

Canadian Defence Measures

AMONG defence measures recently announced by Mr. Ralph Campney, Canadian Defence Minister, were the receipt this year by the R.C.A.F. of a new air-to-sea homing torpedo; the putting into operation of the R.C.A.F.'s new maritime patrol aircraft, the CL-28 Argus; commissioning "soon" of the aircraft carrier *Bonaventure*; and speeding-up of deliveries of the Grumman Tracker [some photographs of which appeared in *Flight* for April 5, pages 444-5].

Hunters for Iraq

FIVE Hawker Hunter 6s are being given to Iraq by Britain in response to a request for assistance in equipping the Royal Iraqi Air Force with modern swept-wing fighters. Announcing this in a Parliamentary answer the Foreign Secretary, Mr. Selwyn Lloyd, said the gift included free delivery, three months' spares and provision of a servicing party.

Music on Ice

A RECORDING of the *Dam Busters' March*, played by the Hallé Orchestra and the R.A.F. Central Band at the R.A.F. anniversary concert in the Royal Albert Hall on April 13 [as referred to on page 536] is being sent to the R.A.F. team working at Vahsel Bay in the Antarctic on aircraft maintenance for the Trans-Antarctic Expedition.

Sea Vixen Actuators

IN a reference to control-surface actuators in the article "Progress with the Sea Vixen" (April 5) it should have been stated that all primary control surfaces on this aircraft are operated by Hobson tandem-piston jacks. These are duplicated units, the two halves of each being connected to separate hydraulic circuits. Six jacks are employed, two for each control axis.

WINNERS of the "airport" competition run by B.B.C. children's TV were given flights in—and allowed to fly—the Sperry Gyroscope Company's Prince. Seen with Sperry pilot J. S. King is Michael Glen.

The Jet *v* Turboprop Cost Controversy

By F. H. ROBERTSON, A.F.R.Ae.S.

THERE is a further contribution to the most controversial of air-transport issues—the likely comparison between jet and turboprop economics. The story to date is briefly as follows. Lord Douglas, in his Brancker lecture on February 11, concluded that the jet, design-range for design-range, would always be 10 to 15 per cent more costly to run than the turboprop. "Flight" challenged this as rather too unfair to the jet, prompting Mr. Robertson to weigh in even more heavily on the side of the turboprop. Mr. Whitby of B.E.A. moderated certain of the more vehement pro-turboprop assumptions made by Mr. Robertson, who now resumes his turboprop offensive. Notwithstanding the airlines' trend towards jet transportation for medium- and short-stage operations as well as for long-haul work, we have yet to hear stated a convincing case for the economics of the jet. Are fare-paying passengers of the future going to get a fair deal from the airlines?

The piston engine: what can most economically replace it—turboprop or turbojet?

MY congratulations to Mr. Whitby for his interesting and constructive comment (*Flight*, April 5) relating to my previous article (March 8) on the evergreen topic of turboprop *v.* turbojet. There are, however, one or two points in Mr. Whitby's note with which I would like to take issue.

First Cost.—I agree with Mr. Whitby that £9/lb W_1 (weight less fuel and payload) is becoming out of date and that £14/lb is a modern average. I have collected together all the purchase-price quotations I can find and these produce the following averages:—

Three outdated piston types	...	£ 7.5 /lb	× W_1
Three current piston types	...	£ 9.65/lb	
Three current turboprops	...	£11.25/lb	
Four projected turboprops	...	£11.33/lb	
Two current turbojets ...	...	£15.5 /lb	
Four projected turbojets	...	£15.67/lb	

It is quite clear that turbojets cost more to buy (per lb W_1) than turboprops. Whether this is a function of speed or empty-to-gross weight ratio I don't know; but I have confirmed the trend by production cost estimates of my own preliminary designs.

I suggest, therefore, that if one wants to bring my formula up to date, one should use £12/lb for *turboprop* projects and £16/lb for *turbojet* projects (supersonic projects will probably be even more expensive).

Since the value of an empirical formula lies in the ease with which it can be remembered and used, I suggest continued use of the factor 1,000 allied to a "memory" note of £9/lb W_1. A linear slide-rule correction can then be made for any aircraft, using either a statistical average or an estimated cost.

Spares Cost.—Mr. Whitby does me an injustice in assuming that I have allowed nothing for spares. The factor 1,000 in the first part of my formula is made up thus: $A(C_1 + B\,C_2)$, where C_1 is first cost and C_2 is an allowance for spares, repair and maintenance.

Annual Utilization.—I have no quarrel with Mr. Whitby's figure of 2,250 hr for B.E.A.'s European routes. For a general formula, I still think 3,000 hr represents a more realistic world average.

To correct my formula for utilization, it is quite satisfactory to alter the factor in the first part linearly from 1,000 for 3,000 hours per annum to 2,000 for 1,000 hours per annum (see R.Ae.S. *Journal*).

I believe that, on short-medium ranges, as traffic rises, utilization will rise considerably. If one thinks of a mean stage-distance of 400 nautical miles, then a 390 kt turboprop could do eight return trips between 06.00 hours and 23.00 hours, allowing 40 minutes turn-round. In the same time, a 480 kt turbojet could do nine return trips. In both cases the annual utilization would be about 4,400 hours. Assuming one spare aircraft to cover each three such stages, we have an annual utilization per aircraft of 3,300 hours.

Fuel Cost.—Mr. Whitby's figure of 20d/gal is no doubt more correct for B.E.A.'s (and, I believe, B.O.A.C.'s) costs at London. My figure of 24d/gal is a more realistic world average. Again, a particular case can be estimated by altering linearly the factor 10,000 in the second part of my formula.

Existing Aircraft and Known Projects.—For some reason or other, Mr. Whitby has altered my figures before restating them and I can't get his figures on *my* slide-rule! Suppose we forget it! The real outcome is that, by underestimating first cost, I show the jet to be 23 per cent dearer to run whereas Mr. Whitby, by being conservative on utilization, shows it to be 6 per cent dearer to run. The point is, *it is dearer to run.*

Hypothetical Designs.—Now we come to the nub of the problem. It is really no good comparing Mr. A's turboprop, designed in 1948, with Mr. B's turbojet, designed in 1951. Not only are they really not contemporary but different firms have different efficiencies (and deficiencies). The only way to get a satisfactory

THE JET *v* TURBOPROP COST CONTROVERSY . . .

answer is to design both aircraft yourself, and this is what I have done.

Mr. Whitby is quite right to ask why my turbojet is only about 3 per cent better than designs already proposed whereas my turboprop is 25 per cent better than its contemporaries. The answer is simple. The new turbojets are very good designs. Using the very latest engine data and the most careful weight and drag predictions, I can only beat them (on paper) by a small margin. On the other hand, I have yet to see what I would call a really inspired turboprop design.

Some of the difference is due to propeller design. A lot of it is due to engine performance and, with due deference to Mr. Whitby, improvements in turboprop engines will not necessarily be reflected in turbojets, because a rise in thermal efficiency in the former is directly reflected in the performance whereas a similar rise in the latter is usually accompanied by a drop in propulsive efficiency. A lot more of the difference is due to designing for the right payload and cruising speed.

Since the *Flight* issue of March 8 appeared I have done more work on the two hypothetical designs quoted, and would like to conclude by restating their parameters and costs using both Mr. Whitby's constants and my own.

	Optimum Robertson European Turbojet	Optimum Robertson European Turboprop
First cost (£/lb/W_1)	16	12
Weight, less fuel and payload W_1 (lb)	56,000	62,000
Cruise speed V (kt)	490	390
Capacity payload (lb)	21,000	26,000
Capacity fuel (lb)	45,000	20,000
E.S.A. range (n.m.)	2,750	2,300
E.S.A. range for 500 n.m. stage (n.m.)	1,050	800
Payload for 500 n.m. stage (lb)	21,000	26,000
Fuel for 500 n.m. stage (lb)	17,200	6,950
D.O.C.—500 n.m. d/ton/n.m.	17.40	11.48

The foregoing figures are arrived at by using my formula with the first factor corrected to match the first cost. Utilization is 3,000 hours and load factor ¾. The turbojet is *50 per cent dearer* to run.

According to B.E.A.'s 1955-56 annual report, their average Viscount utilization was in fact 2,217 hours and load factor 61 per cent. If we use these figures instead of mine and also take Mr. Whitby's first cost of £14/lb and fuel cost of 20d/gal for both aircraft, we get the following:—

		Turbojet	Turboprop
D.O.C. 500 n.m.	d/ton/n.m.	19.90	17.50

My conclusion from all this is that if one assumes the same first cost per lb of aircraft, in spite of evidence to the contrary; the same rather low utilization for both, in spite of rising trends; and, finally, an artificially low fuel cost by world standards—in fact, if one leans over backwards to try and make the jet look good, it still comes out nearly 14 per cent dearer.

If one is more realistic and compares the two types on a similar route structure, then the turbojet (at its best) is going to be at least 30 per cent dearer, and probably more, than a comparable contemporary turboprop.

Formula Check Point.—From B.E.A.'s annual report 1955-56, I see that the Viscount fleet averaged out at 34.6d/ per short-ton statute mile total cost. Of this, *19.2d* represented direct operating cost. Utilization averaged 2,217 hours per annum and load factor 61 per cent. Using my formula as it stands but correcting for utilization, load factor and units, we get:—

$$\left\{\frac{\left[1{,}000+\frac{1{,}000\,(3{,}000-2{,}217)}{2{,}000}\right]W}{PV}+\frac{10{,}000\,F}{PR}\right\}\frac{67}{61}\times\frac{2{,}000}{2{,}240}\times\frac{1}{1.15}$$

Or:-

$$\left(\frac{1{,}392\,W}{PV}+\frac{10{,}000\,F}{PR}\right)0.853$$

For the Viscount 701, $C=$£9/lb W_1; $W_1=36{,}000$ lb; $V=279$ kt; $P=11{,}630$ lb; $F=6{,}900$ lb; $R=800$ n.m.

$$\text{Thus D.O.C.}=\left(\frac{1{,}392\times 36{,}000}{11{,}630\times 279}+\frac{10{,}000\times 6{,}900}{11{,}630\times 800}\right)0.853$$

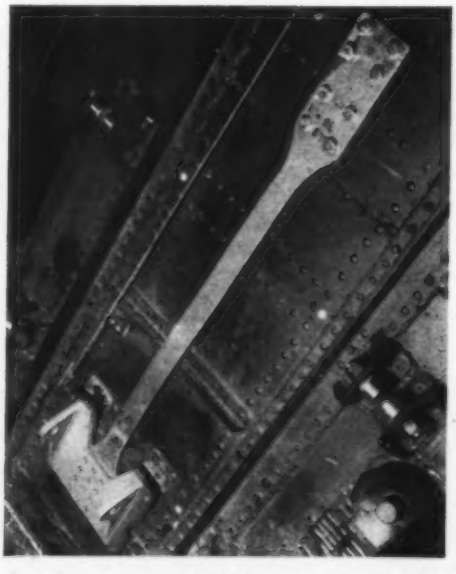
$$=(15.42+7.42)\ 0.853$$

$$=19.5\text{d/short-ton statute mile.}$$

CUSHIONING THE PILOT

TWO new fittings for ejection seats have been designed by Chance Vought for installation in U.S. Navy aircraft. They are a stainless-steel seat-mounting strap designed to stretch and absorb heavy-landing loads, and a special foamed plastic seat-cushion designed to absorb hard-landing shocks.

The stainless-steel strap, which is 3ft in length, is interposed between the aircraft structure and the seat. Under emergency stresses it will stretch several inches, absorbing shock before it affects the pilot's spine and avoiding sharp load-reversals normally experienced under these conditions.



The seat-anchorage strap attached to a cockpit rear bulkhead.

The seat-cushion consists of a layer of foam-rubber padding applied to a shaped pad made of rigid foamed plastic which collapses under a given load. Such material has already been used for crash-helmet linings and is stated to have been found to give better protection than rubber padding. The cushion is shaped to prevent the pilot's hips from slipping forward during crash-landing; and forward extensions support his thighs during ejection.

Tests were carried out by the U.S. Navy in which two fuselages, one with a standard seat installation and the other with steel strap and plastic cushion, were subjected to crash-landing loads with instrumented dummies in place. Straight and suddenly-reversed loads were reported to be greatly reduced in the modified installation. The equipment is now to be applied to F7U Cutlasses and other Navy aircraft. Several score of back injuries have been reported by both Navy and Air Force after wheels-up landings or nosewheel-strut collapses.

AUSTRALIAN AIR EXPANSION

WITH the Australian Cabinet announcement in Canberra on April 9 that a supersonic aircraft is to be built in Australia "with a performance equivalent to that of the Lockheed F-104 Starfighter," it seems clear that the Federal Government has decided to maintain and expand the Australian aircraft industry.

The announcement was made in a brief statement by the Minister for Defence Production, Mr. Howard Beale, and it is believed that the aircraft will in fact be the Lockheed Starfighter, manufactured under licence in Australia.

An Australian technical mission is to leave soon for the U.S.A. to obtain production details, and in addition to "technical know-how" Australia will also probably obtain a free supply of jigs and other equipment, with personnel to use them in local factories.

According to the Canberra correspondent of the *Financial Times*, the Australian Government feels confident that later—with full mutual aid from the U.S.A.—"most modern types of supersonic aircraft" will be built in Australia.

Flown by W/C. R. P. Beamont, O.B.E., D.S.O., D.F.C., manager of flight operations and chief test pilot to the English Electric Co., Ltd., the first P.1B breaks away after a photographic session during its maiden flight—on April 4.

PROGRESS WITH THE P.1

Britain's Principal Fighter Programme

By THE TECHNICAL EDITOR

RECENTLY the English Electric Company successfully flew the first of the P.1B development aircraft which are expected to lead into the R.A.F.'s next—and, according to the Defence White Paper, final—family of manned fighters. It is appropriate at this time to review the genesis of the design and to recount some of the factors which are affecting its development.

No purpose can be served by resurrecting dead issues, but the fact that the P.1 is at present the only British supersonic combat aeroplane can be attributed squarely to the 1945 decision that we should not attempt to design a piloted supersonic research aeroplane but should rely on results obtained with air-launched scale models. It was not until 1947 that the Ministry of Supply issued a specification (E.R.103) for a manned supersonic research aircraft. By 1949 such manufacturers as English Electric and Fairey had given the problem a great deal of thought, and both companies submitted proposals. Fairey's aeroplane became the record-holding F.D.2, virtually a minimum supersonic envelope for a pilot, engine, and fuel.

English Electric proposed a rather larger machine, powered by two turbojets mounted one above the other and fed from a common pitot intake in the nose. Moreover the company's project team differed from Fairey in electing to use a heavily swept wing of moderate taper, rather than the structurally simpler delta. The basic design project began under Mr. W. E. W. Petter in 1949. When Mr. Petter left English Electric the following year, the programme advanced under Mr. F. W. Page, who since that time has been chief engineer of the company's Aircraft Division.

Basic gathering of data was the first task, and various American agencies were generous in providing information on the stability, control and other problems of such aircraft as the Bell X-1 and the North American F-86. One of the latter machines had, incidentally, been flown at transonic speed in 1948 by Mr. R. P. Beamont, English Electric chief test pilot. Naturally enough, the British company felt that most of the work for which a purely experimental supersonic aeroplane could be built had already been done across the Atlantic. It seemed logical, therefore, to look upon the project as a basis from which could stem a fighter, and the company so designed the aircraft as to permit a certain amount of armament and other military equipment to be incorporated should this become a requirement.

English Electric were singularly well equipped to undertake a programme of such a nature. To their 9ft by 7ft slow-speed tunnel the company had, in 1950, added a tunnel capable of transonic operation. Powered by a Nene turbojet this was the first privately owned transonic facility in Britain, and it was from the start invaluable.

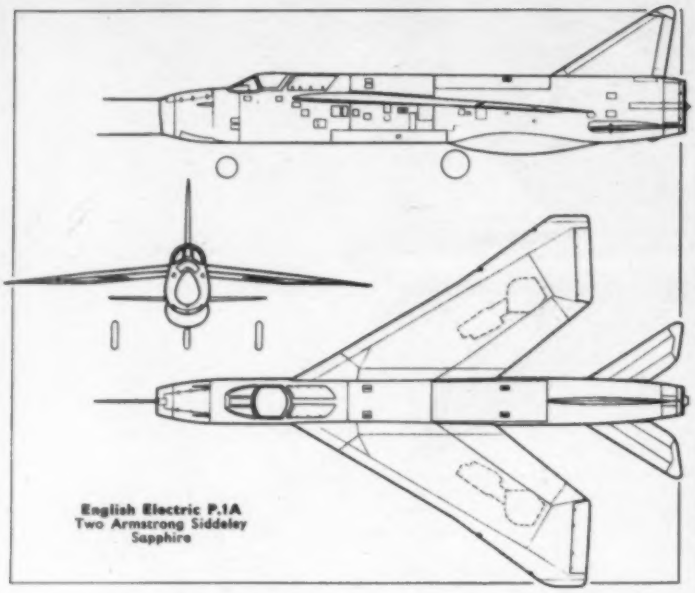
To put the programme on an even surer basis the Ministry of Supply sponsored the development of an *ad hoc* aircraft for research into the low-speed behaviour of the English Electric design. Tunnel evidence had left little room for doubt about how the supersonic machine would fly, but the value of trials at Reynolds numbers appropriate to full-scale experience could not be denied. As is frequently the case, the task of building the research machine fell to Short Brothers and Harland, and they flew the aircraft (the S.B.5, serial WG 768) on December 2, 1952.

Over the ensuing years this machine has flown with wings swept at 50, 60 and 69 deg, with a high and low tailplane and with a variety of special equipment. It served to confirm English Electric's chosen configuration of a 60-deg wing and low-mounted horizontal tail, and has since been instrumental in evaluating leading-edge design and other variables.

Official interest continued to be focussed principally upon the guided weapon, and it was not until 1953 that it was finally acknowledged that a supersonic fighter would have to be developed. Then, belatedly, the F.23 specification was drawn up. In view of its suitable size and characteristics it was logical to ask English Electric to turn their research aeroplane—which by then was called the P.1*—into a weapon system to meet the requirement.

[*continued overleaf*

* *The P stands for neither Pursuit, Petter nor Page; if anything it means merely "project."*



English Electric P.1A
Two Armstrong Siddeley Sapphire

PROGRESS WITH THE P.1 . . .

It is unfortunate that, perhaps owing to a misconception of what it means or mere lack of experience with advanced types of aircraft, the Weapon System Concept is looked upon with some disfavour in certain British quarters. In the design and development of an operational supersonic aeroplane every factor which can affect combat performance of the machine must be integrated with every other item at the earliest possible stage of design. English Electric appreciated from the outset that the mere installation of two guns and a gun-sight was incompatible with the achievement of an efficient combat system. Accordingly the whole basis of the programme was enormously broadened to include such diverse aspects as production tooling, tropical and cold-weather operation and field maintenance.

Such was the magnitude of the programme that it was decided to order what, by British standards, was an unprecedented number of prototypes. It was decided that an intermediate development design, designated P.1A, should account for two complete aircraft and one airframe for static testing, and that a later development, the P.1B, should account for three prototypes and 20 pre-production aeroplanes. Such a quantity was considered adequate for the immediate programme of research and development facing the company. It marks a welcome change in thinking, which should prevent repetition of the unhappy histories of some earlier R.A.F. fighters.

U.S.A.F. programmes have been financed in an even more grandiose and determined manner; development test flying of the Convair F-102 (*Flight*, April 19) was undertaken by 52 aircraft, together with two TF-102 two-seaters, and at any given time several F-102s were employed on drag measurements alone. We in Britain simply cannot afford to operate on such a scale. Our 20 extra P.1 development aircraft are the most we can deploy to solve the technical problems ahead. They will not necessarily allow the P.1 development cycle to be quicker than that of any earlier fighter; on the contrary, they are needed to get the huge task done in anything like a reasonable time.

While the P.1A was passing through the detail design stage it was generally accepted that future fighters would be individually so expensive that they would be bought in much smaller numbers than their predecessors. Moreover, it was generally accepted that there was little point in developing a complicated supersonic aeroplane for the defence of Britain unless that aircraft could operate at night or in bad weather. It is pertinent to record that, contrary to a decision previously taken by the U.S. Air Force, the British Air Staff considered that the full requirements for all-weather interception could be met only by a two-seat aeroplane. English Electric felt that, as the ultimate aim was the elimination of the human crew entirely, it was logical to minimize the crew as far as possible and make automatic equipment perform all the essential functions of the weapon system.

This philosophy fundamentally (and, in general, advantageously) affected the size, shape and ability of the aircraft; but it has naturally placed a considerable strain on the very many firms responsible for delivering the airborne equipment. When the aircraft was being planned no British accessory supplier had any real experience of designing equipment for supersonic aircraft application. From the view-point of temperature, the ruling design condition was that appropriate to "tropical day at sea level," to which kinetic heating and skin friction in the P.1 can add 50 or 100 deg C. Full cockpit refrigeration was a requirement from the start, and even the basic structure of the machine had to be unusually carefully designed in order to meet requirements which previously were peculiar to the U.S.A.

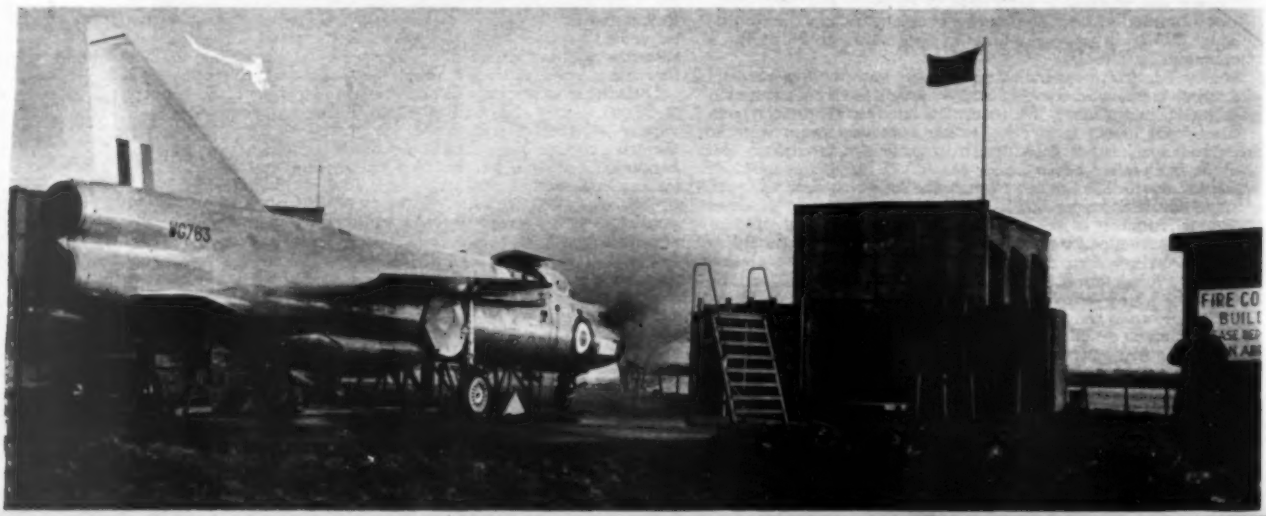
As already stated, the wing is of a peculiar family which can be considered either as a "plank" wing swept back to an angle of 60 deg on the leading edge or as a notched delta. The latter metaphor is really incorrect, since the P.1 retains the conventional horizontal tail surface, with a plan-form very like that of the wing. The vertical tail is almost of delta shape.

The wing, which spans 36ft from tip to tip, is evidently an integral tank, and it must have very thick skins between the spars. Photographs show that the thickness/chord ratio is around five per cent, measured parallel to the longitudinal axis of the aircraft. It is worth noting that the aerodynamic chord is considerable—and, in fact, the wing is distributed over an exceptional proportion of the overall length of the aircraft. It thus becomes much less of a stumbling-block to the achievement of the optimum axial distribution of cross-sectional area. A diagram published in our issue of December 2, 1955, indicated how this factor has facilitated conformation to the area rule to minimize transonic drag.

Similar considerations resulted in the unfamiliar, but efficient, profile of the fuselage—which we once described as having "all the shapeliness of a suitcase." The considerable length of 52ft reflects the difficulty of accommodating two powerful engines fed from a nose intake, together with a cockpit, armament and all operational equipment, in a body profile of the correct fineness-ratio. Consequently much of the P.1 fuselage is occupied by intake ducting or tail-pipe, although with proper design this should not greatly penalize engine performance. Considerations of c.g. and fuselage depth probably precluded positioning both engines at the rear, so they are longitudinally separated and reached, or removed, through large hatches in the top or bottom of the fuselage. Clearly, both engines cannot drive a single accessory gearbox.

All flying controls must be fully powered and irreversible. The rudder is tabless and was originally horn-balanced. The horizontal tail comprises low-mounted, swept "slabs" separated by the lower jet-pipe. The ailerons are of very unusual geometry in that,

At the Warton butts is WG 763, the second P.1A—note ventral fairing—with Sapphires roaring and solid shot spewing from the two 30mm Aden guns. Well might the onlooker stop his ears; even the helmeted English Electric test pilot in the cockpit must be deafened.



Like a fencer's mask, P.1A number WG 760 wears its strange intake guard on a sunny day at Warton. Ranged alongside is WG 763

occupying as they do positions appropriate to those of an unswept wing (i.e., parallel to the transverse axis) they straddle the tips of the wing from what might be termed the leading to the trailing edges. To a considerable extent, therefore, aileron loads introduce pure bending in the wing, substantially reducing torsional deflections and consequent aileron reversal. Although the ailerons were originally horn-balanced they will be inset in future wings.

In order to achieve optimum flow and isobar patterns over the wing English Electric incorporated fore-and-aft slots in positions akin to wing fences. These "saw-cuts," which were developed on the S.B.5, give less drag than fences and are not so susceptible to damage.

A single large section of flap occupies each trailing edge from the fuselage to near the inner end of the aileron. On the P.1A an area-increasing pattern has been adopted, and each flap section moves out parallel to the longitudinal axis of the aircraft; were the flaps to move along the chord-line of the wing their inner ends would immediately foul the fuselage.

To British Messier went the onerous task of designing the undercarriage. The steerable nose gear of the P.1A is very short and turns through 90 deg as it retracts forward to lie flat under the intake ducting. The main legs are attached roughly in the geometric centre of each mainplane and retract outwards. Consideration of the relative inclinations of the hinge axes and the main-wheels explains why the latter turn through some 60 deg in order to lie within the thin wing. Accommodation of the main units within the wing was accomplished only by employing much steel in the leg fork and by choosing a tyre pressure of 280 lb/sq in.

A unique feature of the arrangement is that the retracted wheels are enclosed by large doors hinged inboard of the wheel wells, i.e. on the same side of the well as the leg. The arrangement has given the P.1 a very wide track and excellent stability on the ground—although, short of employing a variable-incidence wing, it is doubtful if the maximum desirable ground angle can be employed to permit the optimum lift coefficient of the wings to be realized. Tyres, wheels and Maxaret-equipped brakes are by Dunlop.

Selected powerplant was the Armstrong Siddeley Sapphire, probably with a dry rating of about 7,500 lb thrust. Martin-Baker supplied the Mk 4 ejection seat, Irvin the braking parachute and much equipment came from the English Electric Group. The three P.1A airframes were constructed at Preston in production jigging. The first machine, which bears the serial number WG 760, flew from Boscombe on August 4, 1954, in the hands of Mr. Beamont.

Since that date WG 760 and its sister ship WG 763 (of which more anon) have completed more than 500 successful flights. The two prototypes have been flown by all kinds of pilots from the Services and elsewhere, who have found them completely straightforward flying machines presenting no special conversion problems. Pilots of the Central Fighter Establishment have reported very favourably on its behaviour.

On its first flight WG 760 exceeded the speed of sound without the pilot being aware of the fact. A few days afterwards data-reduction on a later flight showed that the machine had gone supersonic in a climb, although position-error in the airspeed system had caused the Mach-meter to record a maximum of 0.95. No special effects had manifested themselves, and Beamont, who was flying, was surprised when given the news. Notwithstanding a claim promoted in respect of the French Gerfaut, it seems that this was the first occasion on which a conventional fighter exceeded the speed of sound without diving or employing reheat (afterburning) or rocket boost. From October 1954 supersonic flying was conducted as a matter of course.

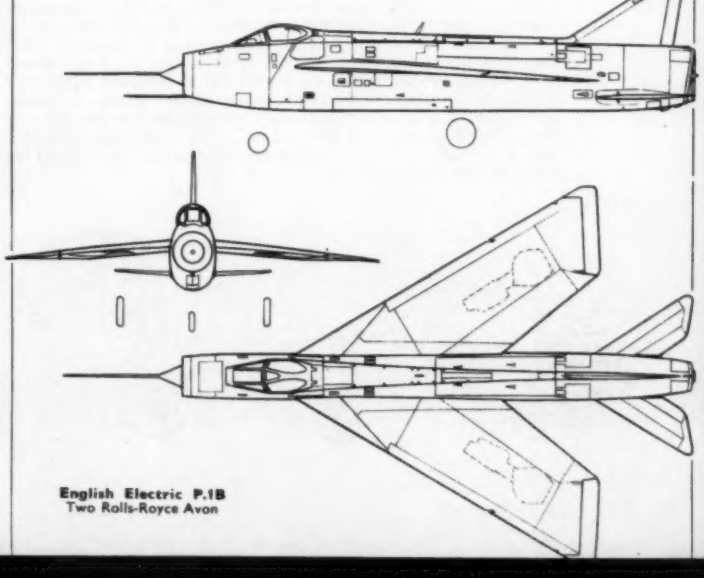
The second P.1A, WG 763, took to the air in July 1955 and differs from its data-gathering predecessor in having two 30mm Aden guns mounted in the forward fuselage, firing from blast tubes high on each side of the nose. It also carries additional operational equipment. Gun-firing tests in special rigs began at the company's experimental base at Warton in 1953. Owing to the fact that the muzzles of the guns are situated well back from the engine intake no surging or compressor-stalling has been experienced in air-firing trials. The latter began more than a year ago and have ranged over a very wide band of speeds (including supersonic) and altitudes.

From 1954 flight trials with the two P.1As have been backed up by the most extensive tunnel testing ever conducted on a British aeroplane, and by a tremendous programme of data recording and electronic computing with which every facet of the behaviour of the aircraft has been fully explored. One of the results of this may well be that the design has been made to offer an extremely stable platform for the launching of weapons, without the need for recourse to auto-stabilization. This statement is not meant to imply that auto-stabilization is not fitted, but it underlines the difference between the inherently rock-steady flight of the P.1 and the rigidly controlled trajectory of several trans-atlantic fighters which are forced to rely on auto-stabilization about two or three axes in order to fly at all.

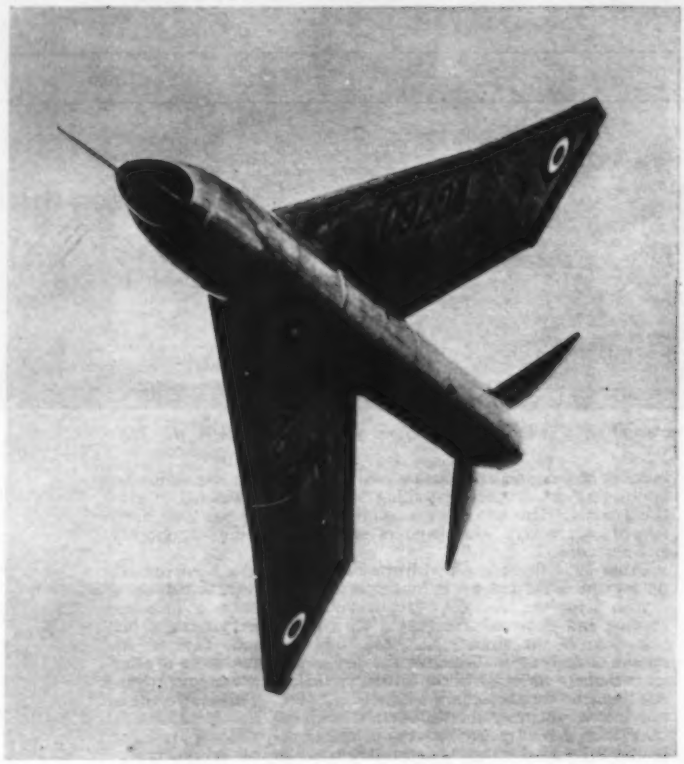
Few would be bold enough to deny that the question of fighter armament is still somewhat in the melting pot. While all are agreed that, for most purposes, the ultimate weapon for such aircraft is the guided air-to-air missile, it is prudent to retain at least the capacity for operating with conventional weapons. Thus, although there is no doubt that guided weapons will form the main armament of the definitive P.1 fighter, the aircraft has also been planned to carry guns, and, no doubt, spin-stabilized rockets. It would be logical for special provision to have been made for permitting the type of armament carried to be changed rapidly and easily during field service. All the equipment associated with the various types of armament is likely to be available in package form within the time scale of the aircraft, thus fulfilling a major requirement of the weapon-system doctrine.

Most of the flying with the two P.1A prototypes has been carried out from the company's airfield at Warton. Both aircraft have, however, used smaller airfields, and it is known that the eventual production aeroplane will be well suited to the types of airfield from which it will be required to operate (i.e., the present R.A.F. or NATO operating platform. One of the P.1As has made a number of G.C.A. landings.

Operating largely over the Irish Sea (*Flight*, March 1) supersonic flights have been made at altitudes down to well below 10,000ft (the startling minimum may not be quoted), and virtually the whole flight envelope of the P.1A must now have been explored.



English Electric P.1B
Two Rolls-Royce Avon



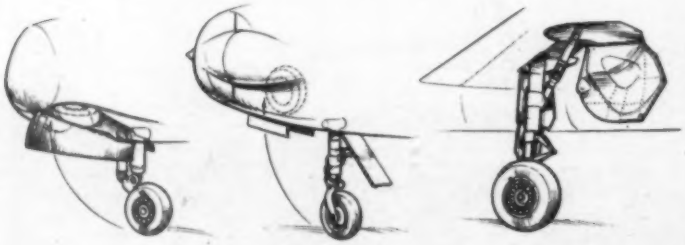
In a tight turn, WG 760 displays its new wing form.

PROGRESS WITH THE P.1 . . .

The P.1A can in fact fly supersonically for extended periods without using reheat. Since all power systems and essential services are energized by both engines it has been found possible to cruise with one powerplant shut down (there are, of course, no asymmetric problems). This may well be the procedure giving maximum operational endurance. Should such a contingency arise, it would also be possible to ferry the aircraft from one base to another using only one engine throughout. For maximum range at altitude—as distinct from endurance—the optimum flight-plan is sure to specify the use of both engines, shutting off one powerplant at the end of the flight when the aircraft has descended to a low altitude. This has been found to apply to the F-101.

The advantage of having two engines cannot be stressed too highly, and it is a great comfort to a pilot when he is flying so advanced an aeroplane. In single-engined machines of comparable performance a dead-stick landing is invariably difficult and dangerous, and the loss of the engine usually leads to a bale-out.

Further augmentation of thrust, particularly at high supersonic speeds, can be provided by employment of reheat. Initially neither of the P.1As had such augmentation, but the first machine, WG 760, was modified for elementary reheat trials late in 1955. The original powerplants were replaced by specially developed Sapphires incorporating afterburners with fixed-area propelling nozzles set to give optimum thrust in the reheat condition. Although such an arrangement eliminates most of the mechanical problems associated with variable-area nozzles it drastically reduces the maximum thrust available in the non-reheat condition. Thrust figures for the powerplants fitted to WG 760 may not be published, but it is a straightforward exercise to calculate what they might be. Assuming that the basic engine has a dry thrust of 7,500 lb, reheat might bring this up to between 9,500 and 10,000 lb. Working backwards from the optimum size of propelling nozzle, the dry thrust with such an arrangement can scarcely exceed 5,000 lb, and may be even less. This handicaps performance and might even make reheat mandatory for take-off and for much of the flight envelope.



From left to right these sketches show: the nose undercarriage of the P.1A (with the wheel stowed flat); the nose undercarriage of the P.1B; and the port main undercarriage of the P.1B.

The third P.1A airframe has been structurally evaluated at Warton, and was finally tested to destruction. Last December WG 763 flew to Turnhouse Airport, Edinburgh, on a mission described as "in relation to the installation and testing of radar equipment by the Ferranti company." For some time the same aircraft has also been fitted with a trim, yet capacious, bulge on its underside (seen for the first time in a photograph on p. 542). This may be a tank, or a fairing for a rocket motor—or perhaps both. The trial installation does not seem to impair the supersonic performance of WG 763, and the bulge was allowed for in the area-ruling.

Meanwhile, WG 760, the original reheat aircraft, is conducting flight trials with a slightly revised wing with a kinked leading edge. This does not imply that the aircraft has suffered buffet or pitch-up problems similar to those encountered by aircraft of earlier generations to which a superficially similar modification has been made. The new wing is intended to provide the optimum shape of camber for achieving the maximum ceiling and the best range at subsonic or low supersonic speeds. Obviously such conditions call for flight at rather greater angles of attack than the original supersonic design-case, and consequently require not only a fair leading-edge radius towards the tip but also appreciable camber. Conical camber, used on supersonic Convair aircraft, reduces induced drag in a somewhat similar manner.

Except at maximum speed, i.e., at very low angles of attack, the new wing should impose virtually no penalty. Moreover it gives a wing tip which—assuming c.g. problems can be overcome—should form a useful attachment-point for stores of all kinds. Probably the missions of the P.1 are so complex that the optimum wing should, like the powerplant, have variable geometry. Throughout, minimum drag—and hence minimum overall fuel consumption—is the primary aim.

It is in such trials that the two P.1As have laid a solid foundation of knowledge for the much more powerful P.1B. They have flown over 500 missions, recording far more than half the total manned-supersonic time logged by British aircraft (a fact which the writer considers an indictment of our overall progress as a nation). Details of the performance recorded by the two P.1As may not be divulged, but Air Marshal Sir Thomas Pike, A.O.C.-in-C. Fighter Command, recently stated that the type had *exceeded* 1,000 m.p.h. (Mach 1.51) in level flight and that the design was "capable of 1,500 m.p.h." (Mach 2.3). No doubt the Air Marshal meant the latter claim to apply to the P.1B.

As stated at the opening of this account, flight trials with the P.1B have now begun. The first machine, XA 847, flew in "Bea's" hands between 12.55 and 1.19 p.m. on April 4. In this period XA 847 flew faster than sound and also posed for the picture on p. 541. Other very successful flights have since been made.

In the P.1B the powerplants are Rolls-Royce Avons of "an advanced type," and their high thrust is further increased by the incorporation of full reheat with a variable-area nozzle. The actual mark of engine fitted may not be disclosed, but it is appropriate to comment that the RA.24 was recently announced as having been type-tested at 11,250 lb dry thrust *without* reheat. Suffice to say that the P.1B has appreciably more than 50 per cent more thrust than the P.1A, and this margin proportionately increases as the Mach number rises beyond 1.

A study of the three-view general arrangement makes it perfectly clear that the P.1B fuselage is quite different from that of its predecessor; in fact it is doubtful if there are many parts common to both types. Notwithstanding the much more powerful engines the body of the P.1B is no deeper or fatter than that of the earlier machines.

The front end and intake clearly differs substantially from the corresponding part of the P.1A. In the only photographs released for publication full details of the intake are hidden. It is pertinent, however, to note that the lip of the intake suggests a circular form, and the presence of a long pitot head concentric with the lip suggests that a centre-body is fitted (and an unofficial published photograph confirms this). The purpose of the centre-body is to create an inclined shock-wave which, under optimum conditions, is focussed on the lip of the intake. Combined with a normal shock across the radial gap between the lip and the centre-body this achieves deceleration of the intake air without a critical loss in total energy.

Direct pitot intakes (i.e., devoid of a centre-body) are satisfactory up to Mach numbers of perhaps 1.3 or 1.35, but begin to fall off in performance to an unacceptable degree at higher Mach numbers. When the P.1A first flew we commented "technicians will . . . note, too, that the intake is of plain open-mouth form lacking the central 'bullet' now considered essential for efficient operation at Mach numbers over 1.3 or so." The complete

PROGRESS WITH THE P.1 . . .

re-design of the P.1B front-end can be taken as indicative of the true supersonic nature of the new aircraft.

Another factor on which we commented when the P.1A first flew was the unusual type of canopy design. In the interests of achieving minimum drag the P.1A has a flush-type hood level with the top of the fuselage. The P.1B, however, reverts to a more conventional arrangement which, with a very small drag penalty, provides the pilot with better all-round vision. The new cockpit enclosure comprises a heavy windscreen—surprisingly, it has a flat front screen panel, not a vee—and a one-piece canopy, hinged at the rear in "clamshell" fashion and glazed with left- and right-hand mouldings of what is probably a sandwich of glass and stretched plastic.

Faced with the drag of a raised canopy, English Electric decided to continue much of the added cross-sectional area back to the fin, in the form of a dorsal spine. This spine is probably packed with various controls and equipment, and must provide a most valuable additional increment of readily accessible interior space. It carries spike and flush aerials.

An outcome of the decision to adopt a truly supersonic front end, with a centre-body intake, and to raise the cockpit, is that the whole front of the aircraft stands higher from the ground. This is perhaps an operational advantage, in that it renders more remote the possibility of the intake sucking up stray objects. Sharp-edged supersonic intakes are not particularly efficient when the aircraft is at rest, and both the P.1A and B have special ground-running intake doors in the walls of the fuselage, which open automatically below a predetermined ram pressure.

For ideal efficiency over the full range of operating conditions a supersonic intake should not be of fixed geometry, but should be capable of variation to suit the ruling conditions of Mach number, ram pressure and other variables. One of the most common methods of achieving variable geometry is to mount the centre-body (or, at least, the front part of it) on rails and arrange for it to slide in and out. This has been done on the engines of the American B-58 bomber, the centre-body spike position being governed by a Minneapolis-Honeywell automatic control system which senses the position of the intake shock-waves.

The P.1B is the first Western aircraft to have a centre-body intake in the fuselage nose, and it is highly likely that it is also the first machine in which the centre-body is filled with radar. Such a volume forms an ideal location for the scanner head and fire-control and seems to offer a singular happy solution to a knotty problem. If radar is, in fact, to be fitted in such a position on the operational P.1 the centre-body may have to be fixed. Variable geometry may then be attained by moving the cowl lip or by utilizing a system of auxiliary doors, such as those which the P.1 already has.

As previously noted, the P.1A nosewheel retracts flat under the intake duct. In the P.1B the "six o'clock" strut carrying the centre-body forms a useful box for the retracted nose gear, and the latter is therefore of completely new design. The wheel is held in a twin fork unit and it retracts straight forwards and upwards, without the leg having to turn.

Another airframe alteration visible in the P.1B is that the speed brakes have been redesigned and relocated. Originally they were mounted on the rear-fuselage sides just ahead of the jet nozzles, and measured perhaps 18in from front to rear and 46in from top to bottom. Each brake was hinged at its trailing edge, in an arrangement somewhat similar to that used on the Trident. In the P.1B the surfaces are almost square, measuring about 28in by 28in, and they are positioned on the upper part of the fuselage near the leading edge of the fin.

Altogether, the P.1B looks a much more advanced aeroplane from its lower-powered predecessor. It is functional where the earlier machine is experimental; and one can sense that the new fuselage holds a great deal more than just a couple of engines.

Following the weapon-system idea pioneered by the U.S.A., English Electric, as prime contractor for the P.1B weapon system, are assigned the massive task of flight-developing all the new equipment which the aircraft is designed to carry. The company themselves assert that their "responsibility for the flight development of the P.1 is very extensive . . . in comparison with that of any other firm building military aircraft in Britain." This is certainly considered judgment, and not swollen-headedness.

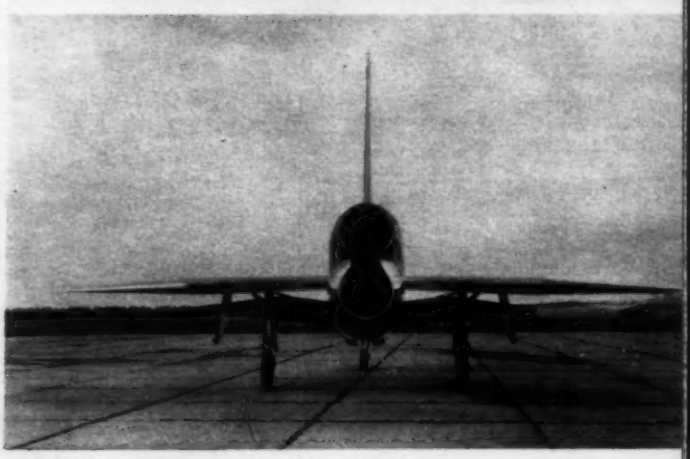
To meet this great task the company have made several major improvements to their main airfield at Warton, on the north side of the Ribble estuary west of Preston, Lancs. Chief of these is an 850-yd extension to the main runway, costing over £250,000. The runway is now 2,850yd long, with concreted over- and under-shoot areas bringing the available maximum up to 3,130 yd. This length is needed for P.1B experimental operations only; the aircraft has already demonstrated its ability to operate from standard R.A.F. airfields.

George Wimpey employed only 30 men but a great deal of machinery in building the runway extension. The work involved filling in a depression with 50,000 tons of slag brought 25 miles from blast furnaces at Darwen, overlaid with 10,000 tons of hard-core to keep the sulphur in the slag away from the runway concrete itself; removing a 60,000-ton hillock; building the runway out over a stream and two roads; and building a new road to full County standards. All this was done in ten months, and without interrupting test flying.

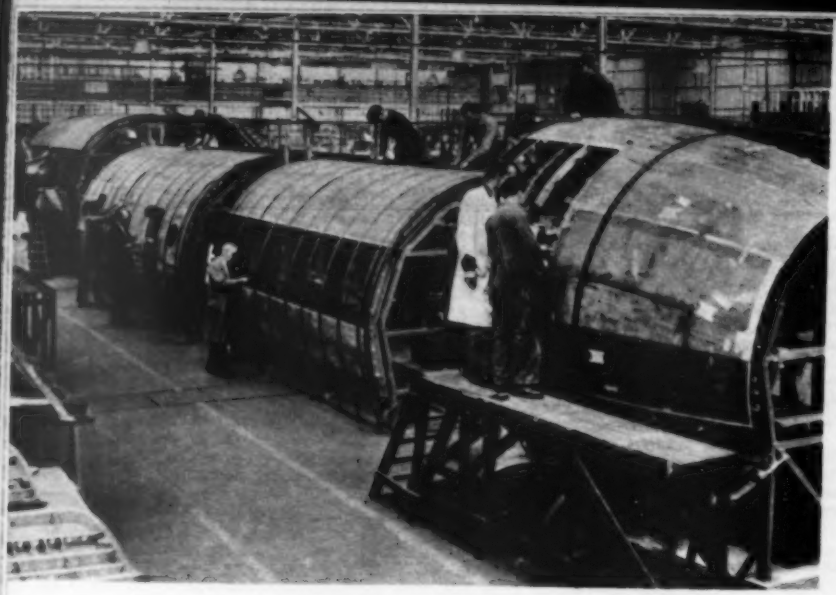
A new control tower is also being built, situated more conveniently for the lengthened runway and equipped with Marconi A.D.F. and other radio aids. Further improvements include the installation of Calvert-type approach lighting and an I.L.S. system. To house the team of over 60 engaged on P.1 flight development a modern office block was recently opened on the edge of the airfield. The aircraft themselves will be based in a large hangar which was until early this year occupied by No. 90 M.U., R.A.F., who cleared it of many thousands of tons of stores in record time.

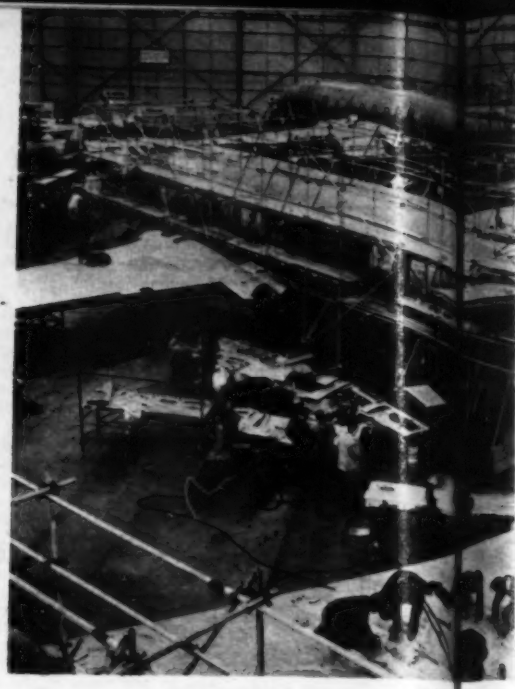
Were a visitor allowed to enter the big Aircraft Division factory at Preston (Manager, Mr. W. Shorrock, M.B.E.) he would see many of the 22 P.1B prototype and development aircraft in advanced stages of completion. He would also see tangible evidence of the starting of full production to meet a bulk order placed last November. This order, while not tremendous in terms of numbers of aircraft, is of far-reaching importance. An operational P.1 is certain to cost at least as much as a Canberra—and probably considerably more.

The development machines are already assigned to a detailed programme. One aircraft will be used for air-firing, another for trials with missiles, and others with powerplants, radar, navigation aids, autopilot, and so forth. By the end of next year, or early in 1959, it should be possible to start releasing P.1Bs (which by then will probably bear a name) to user squadrons of Fighter Command. Never was any aeroplane so eagerly anticipated. As the Chief of the Air Staff recently said, "it is a tremendous improvement on anything we have had before."



While the frontal aspect of the P.1B is notably different from that of the P.1A (above), both sub-types are very similar when viewed from the rear (again the P.1A, with the original wing and no reheat).





CHESTER-BUILT

"Flight" photograph

WITH Heron and Dove output steadily continuing, and work on Venoms, Sea Venoms and Vampire Trainers being reduced, the great de Havilland factory at Chester is turning over increasingly to the building of Comets and Sea Vixens. At upper left are Comet fuselage skin jigs, and the adjacent picture shows conversion of Comet 2s. Particularly impressive is the scene on the left, with Herons and Doves—mostly for export—on the production line. To the left of this picture final assembly of Sea Venoms is discernible. Immediately above is a *Flight* photograph showing Sea Venoms of No. 894 Squadron, Fleet Air Arm; and, below, aircraft of the same type are on final assembly. The first of the new Comets from Chester is due to fly early next summer, and the first Chester-built Sea Vixen should soon follow.

Capital Airlines, American Operators of British Turboprops, Celebrate their Thirtieth Birthday

By M. J. HARDY

"...PRONOUNCED VI-COUNT"

THERE is an engaging, nursery-book quality about the discreet little notice until recently featured in the advertising of Capital Airlines, Inc., instructing the American travelling public how to pronounce the British turboprop airliner which is (almost) as silent as the "s" in its name. There is something flavouring of a giant-killing, it's-too-good-to-be-true fairy tale about the success of the Viscount, and later the Comet, in breaking into the North American market in the face of powerful competition; and about how Viscounts have regained for Capital Airlines a pre-eminent position on a very important route. Like all good fairy tales, this one really begins a long, long time ago . . . to be exact, in 1927.

In April of that year, the Skyline Transportation Co. started to fly mail services between Pittsburgh and Cleveland in an open cockpit, single-engined Fairchild. This concern had, by 1936, grown into Pennsylvania Central Airlines Corporation, with routes covering the Northern and Eastern states. The network was flown by Boeing Model 247D (and, from 1940, Douglas DC-3) twin-engined transports. When America entered the war the airline had developed into one of the largest and most important domestic carriers in the country.

To meet expected post-war traffic demands the first of a fleet of 25 Douglas DC-4 Skymasters went into service in 1946, and these were supplemented on shorter routes by a total of 26 war-surplus Douglas DC-3s; for four years the fleet consisted of just these two types of well-tried airliners. Among the Skymasters, incidentally, were the second, third, fourth, fifth, sixth and ninth production DC-4s—all of which are still in service after ten years. As the Viscount fleet builds up towards its full total, the Skymasters are being sold and already eight have been disposed of. The DC-4s have accommodation for 55-60 passengers each. Three of the DC-3s have been leased as executive aircraft and the rest have 24-passenger interiors. These aircraft have Wright R-1820-G200 Cyclone engines instead of the more usual Twin Wasps.

In 1950 Capital Airlines (the change of name from Pennsylvania Central Airlines had taken place in April 1948) acquired the first of its present fleet of 12 Constellations. These aircraft were recently put up for sale, and the first buyer was California Eastern Aviation, Inc. who purchased two; these aircraft have, however, been leased back by Capital to provide temporary extra capacity.

Post-war Operations. The first full year of post-war operations was not easy for U.S. domestic airlines, and many of them sustained losses. During the 1945-46 expansion period Pennsylvania Central over-estimated its personnel requirements and in 1946 the company lost two million dollars. Because of this, re-equipment plans (a total of 50 Martin 2-0-2s and a few Douglas DC-6s had been ordered) had to be cancelled. The year after was even worse financially, with eleven major carriers in the red, to the tune of over eleven million dollars; but Pennsylvania Central's loss was reduced to half of that incurred in 1946. By 1948 the route network had been extended as far west as Minneapolis/St. Paul, and the airline had eliminated its dependence on mail subsidy. On October 15 of that year the company inaugurated "The Nighthawk" air-coach service, flown after dark between New York and Chicago, with a stop at Pittsburgh; this was the very first air-coach service to be operated by a U.S. domestic airline. At four cents a mile the new New York - Chicago fares were nearly as low as the corresponding non-Pullman railway fares ($29.60 by air coach as compared with $27.30 by rail). The New York - Chicago "Nighthawk" was so successful that another service under the same name was started on April 1, 1949, between Washington and Chicago.

During the nine months ended July 31, 1949, Capital's air coach services had carried 83,323 passengers—67.8 per cent of whom had never travelled by air before—and earned a gross revenue of $1,839,685 (excluding mail) for a cost of $1,564,315, which included $200,000 spent on advertising. A third coach service between Washington and Minneapolis/St. Paul was later inaugurated, followed by a fourth between New York and New Orleans. Capital's coach services were an important factor in putting the airline back into the black (although the first six months of 1948 showed a deficit, a profit of $626,000 was made for the whole year). And in 1951 an interchange agreement with National Airlines was signed, providing a service to Florida for Capital's passengers

The Viscount Order. After the bad years of 1946 and 1947, the company enjoyed a period of steady growth and financial health from 1948 to 1953. The number of passengers carried in 1953 placed Capital fifth among U.S. domestic carriers. In terms of passengers carried, they ranked among the top dozen world airlines every year from 1948 to 1953; but they were unique among these members of the "Big League" (which included Capital's chief competitors—American, United, T.W.A. and Eastern) in not having re-equipped with any factory-new post-war transport aircraft; all the Constellations were bought second-hand.

Although the average stage length in Capital's network was only 297 miles in 1953, the airline found it economical to use four-engined equipment designed for long-haul work. This was later to prove a blessing in disguise, partly because the expense and uncertainty of introducing new types of aircraft were avoided, but mainly because the obsolescence of most of the fleet enabled it to be written off the books by 1953, just when that long-awaited fruit, the turboprop airliner, was ripe for picking.

On April 19, 1953, the Viscount started regular scheduled services—with B.E.A.—in Europe. Less than a year later, Mr. J. H. Carmichael and seven of Capital's technicians and economists gave it their very earnest attention. Much information was supplied to them by Vickers and B.E.A. (some of it of a confidential nature not normally disclosed) and B.E.A. experts worked out a 22-page written statement of results of Viscount operation, including answers to a searching and detailed questionnaire put before them by Capital. In addition, the British airline unselfishly gave Capital three delivery positions in the Viscount queue.

The result is well known. An order was placed in June 1954 for three V.744 Viscounts (Dart 506 engines), with an option on 37 more of the V.745 and V.745D types. This option was taken up in August and a further option taken on 20 more V.745s, the order for which was confirmed in December. Thus within a year an American airline committed itself to the purchase of what was then the largest turboprop airliner fleet (in terms of numbers of aircraft) ever to be ordered; only B.E.A.'s Viscount/Vanguard fleet will—when deliveries are completed—exceed it in numbers. And, last July, 15 more aircraft of the V.745D series were ordered to supplement the original 60, both to provide extra capacity in view of the greater than estimated annual traffic increases in 1955 and 1956, and to enable two new C.A.B.-approved routes to be operated. It was originally intended that the 60 Viscounts, which could produce over 2,000,000,000 seat-miles annually, would replace all piston-engined aircraft in service, but because of ever-growing traffic demands the ideal of a one-type fleet was abandoned. Capital's expression of confidence in Vickers-Armstrongs and Rolls-Royce now totals $83,000,000 (nearly £29¼m) in hard cash.

Capital's decision to order Viscounts was a purely commercial one; that is to say, the Vickers turboprop transport was selected —in the face of keen competition from rival American products —entirely on its technical and economic merits. The company chose the Viscount just as K.L.M. had selected the DC-2 and Swissair the Lockheed Orion twenty years before—because, for

their particular purposes, it was significantly better than the best competing aircraft in its class.

Naturally, a decision so radically different from the current trend of American thinking evoked some criticism. It was to gauge and anticipate such resistance that, instead of buying 40 Viscounts right away, Capital ordered three, with an option on the rest. But the travelling public's reaction was almost wholly favourable; it expressed itself in thousands of letters, almost all of them approving; only eleven were critical.

Capital Viscount Features. "I couldn't be more pleased if it had been designed to our specifications," said Mr. Carmichael of the Viscount. But, for Capital as for every other customer, the Viscount was—paradoxically—both custom-built and mass-produced. T.C.A.'s V.724 Viscount was the parent of the V.744 and V.745 versions for Capital Airlines (described in detail in *Flight* for July 15, 1955) and many of the modifications first requested by Trans-Canada were incorporated in Capital's aircraft. Among the main changes were the installation of American flight instrumentation and radio; redesign of the flight deck to transatlantic standards to permit two-man operation; strengthening of the undercarriage to permit landing at greater weights; fitting of "carry-on" luggage racks; provision of integral, hydraulically-operated passenger steps—made by the Heston Aircraft Co., Ltd.—on the twenty-ninth and subsequent aircraft; and installation of Bendix C-band weather radar on the sixtieth and subsequent aircraft. Early in 1956 counting accelerometers were fitted to the fleet; these instruments will eventually be replaced by a strain-gauge recorder fitted to the bottom boom of the wing spar.

To speed up Capital's turn-round times, a very interesting propeller brake unit of Dunlop design has been fitted to the two port airscrews only of each Viscount; operating simultaneously with the lowering of the integral steps, it stops the propellers immediately. Also, by preventing them from windmilling in high winds, these brakes provide extra safety during embarkation. Most of Capital's Viscounts have provision for 5-abreast seating if required and (for use on delivery flights only) the attachment of two external slipper tanks.

Initial Services. On May 17, 1955, Mr. Carmichael took delivery of his first Viscount at Vickers-Armstrongs' airfield at Wisley, Surrey. On July 26 the first Capital Viscount service was flown; at first there were three round trips daily between Washington and Chicago (one direct, one stopping at Pittsburgh and one beginning at Norfolk). Washington - Chicago was both the longest non-stop route (603 miles) and the most important in Capital's network, and the Viscounts were in competition with DC-7s and Super Constellations. A second, daily-except-Saturdays Washington - Chicago service was started a few weeks later, and by November Viscount travel had proved sufficiently attractive to justify the revival of Capital's practice of naming particular services. "The Diplomat" (Washington - Pittsburgh - Chicago), "The President" (Norfolk - Washington - Chicago), "The Independence" (Washington - Chicago) and "The Constitution" (the evening Norfolk - Washington - Chicago service) were all Viscount-operated. Several Constellation and DC-4 services were also given names, and "The Nighthawk" was once again used for various night coach services. In December, Viscounts were put on to Detroit - Chicago, Washington - Cleveland - Detroit and Washington - Pittsburgh - Detroit - Chicago services, and two months later these aircraft were linking New York, Pittsburgh and Chicago three times daily.

The Viscount's impact upon Capital's route network and competitive position was both immediate and gratifying. Mr. J. B. Franklin, vice-president operations and maintenance, told the Society of Automotive Engineers in Washington, on October 18, 1955, that the new turboprop, with average passenger load-factors between 80 and 90 per cent, had in a very short time restored his company to the position of No. 1 carrier on the highly competitive Washington - Chicago route (an honour it had not held since 1947-48). Three V.744s then in service had doubled the airline's traffic between these points in the first month, and had made Capital "top carrier" within 90 days. By the end of 1955, with six aircraft in service, a higher percentage of Viscount seats was being sold than on any other American-operated transport aircraft (the standard cabin interior accommodates 44-48 passengers).

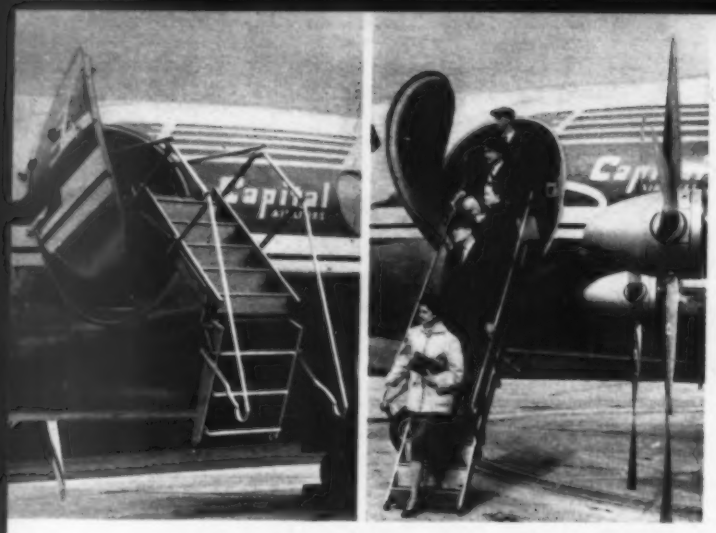
But these gratifying results had not been achieved by relying entirely on the passenger appeal and novelty value; a carefully planned public relations campaign was employed to introduce and advertise it to the American travelling public. For this, Capital was awarded first prize by the American Public Relations Association for "placing the Viscount in a pre-eminent position in the air transport industry." That this position is being maintained is shown by the fact that load-factors on the Washington - Chicago route increased by no less than 199 per cent in the first year of Viscount operations; three times as many passengers were carried over this route in the first four months of 1956 as in the corresponding period of 1955, even though this sector is flown by four major airlines. There are now nine non-stop Viscount flights daily between Washington and Chicago.

More Viscount Services. As more aircraft were delivered during the early months of last year, additional services were put on over a network covering New York, Norfolk, Washington, Pittsburgh, Cleveland, Detroit and Chicago. The frequency of existing Viscount services was stepped up between these points and various night services introduced, both tourist and first class. In May the Viscounts (of which over 20 had then been delivered) started operating into the Southern states with first-class and night tourist services connecting New York, Pittsburgh, Philadelphia, Washington, Norfolk and Richmond with Knoxville, Chattanooga, Memphis, Atlanta, Birmingham, Mobile and New Orleans. In August, Viscount services linked Philadelphia with New York, Detroit and Chicago as well as with the south, and Rochester, Buffalo and Charleston (West Virginia, not South Carolina) were added to the network flown by the British turboprops. A month later they were operating into Baltimore, and by the end of the year into Milwaukee (Wis.), Winston-Salem, Raleigh and Charlotte (N.C.), Huntsville (Ala.), and Flint, Lansing, Grand Rapids, Saginaw and Bay City (Mich.) In November the services were extended still further west to Minneapolis/St. Paul, which was connected to Milwaukee, Detroit, Washington, Norfolk and New York. Greensboro (N.C.) is the latest town to be served by Capital's Viscounts, which now operate all the airline's services out of Idlewild, La Guardia and Newark airports—a total of 40 daily flights.

The sixtieth Capital Viscount was completed last February, about six weeks ahead of contract date; and delivery of the succeeding 15 is scheduled to be finished by August. It is worth mentioning that the first 60 Viscounts form part of the Civil Reserve Air Fleet. Available at 48 hours' notice, this fleet consists of about 45 per cent of the transport aircraft in scheduled service with U.S. airlines and stands ready to supplement the already immense resources of the Military Air Transport Service in case of war.

Capital Economics. By the spring of last year, experience with Viscounts had built up sufficiently to enable the actual operating cost to be compared with the costs estimated when these turboprops had been ordered two years before. Actual costs in cents per mile up to April 30, 1956, based on the operation of a fleet of

Examples of three types which have been the mainstay of Capital's fleet since the war: (reading downwards): N25696, "Capitaliner Williamsport", one of the company's 24 Douglas DC-3s; Constellation N67952, the oldest surviving example—except for Lockheed's "Old 1961" of this type; and DC-4 N79072, "Capitaliner Chicago", sold last year to Riddle Airlines, Inc., of Miami, who have since sold it to Syrian Airways, whom it serves as YK-AAQ.



Built-in, hydraulically retractable passenger steps (made by Heston Aircraft) are a feature of the twenty-ninth and subsequent Viscounts of the Capital fleet. Propeller brakes on both port engines are installed for safety purposes.

"PRONOUNCED VI-COUNT" . . .

60 aircraft were as follows (figures estimated in August 1954 for a 60-'plane fleet are in parentheses): flying, 37.0 (40.5); maintenance, 16.2 (24.2); depreciation, 25.0 (18.4). These give total direct costs of 78.2 (83.1) cents; in addition there were the indirect costs, 79.2 (70.9) cents. Direct and indirect costs totalled 157.4 cents per mile in practice (154 cents per mile estimated). During the nine-month period from July 1955 to April 1956, in which the fleet had increased from three to 19 aircraft, actual utilization was 6.5 hours per aircraft per day, as against the planned 8.5 hours (eight hours was being achieved in July 1956). As utilization increases, direct and indirect costs will drop, as will depreciation and overheads, although maintenance expenses will rise closer to the estimated 24.2 cents as the full maintenance cycle is reached.

The break-even passenger load-factor was 56.8 per cent in practice compared with an estimate of 55.2 per cent, and Capital reckon that it will drop slightly to between 53 and 55 per cent. Actual load-factors have remained consistently around 80 per cent, and have contributed considerably to the airline's $4,000,000 increase in operating revenues in the first six months of 1956.

The Viscount's "new sound in the sky," says Capital, has been responsible for a "new sound in the cash register." In 1955 a net profit of $4,562,276 had been made, but all but $2,685 of this sum represented income from the sale of aircraft. And in 1956 the company incurred a net loss of $1,795,269, although a revenue of $2,455,946 from the sale of aircraft was recorded, or some two million dollars less than in 1955.

That Capital is in the red after a full year of Viscount operations may come as something of a surprise, and would seem to contradict the truth of the actual operating costs just quoted. But a fleet of 60 turboprop transports cannot be acquired for nothing; the re-equipment programme increased extra-ordinary costs from $269,112 in the first half of 1955 to $852,596 in the first half of 1956. This, as well as the big drop in revenue from aircraft sales, accounts for the deficit. Already two of the 12 Constellations have been sold (for a price reported to be about $2,000,000) and the 1957 profits from this source should be much higher. Capital repays the purchase price of each Viscount on a 60-month basis as it is delivered, and as the fleet has built up from six aircraft at the end of 1955 to 60 in March of this year, naturally a good deal of money had to be paid out in 1956.

The Comet Order. Last July, mindful of the need to maintain his company's lead in the face of competition from the Lockheed Electra, Mr. Carmichael placed a $53,000,000 order for four Comet 4 and ten Comet 4A turbojet airliners, deliveries of which will begin late in 1958. Thus Capital will become the first U.S. carrier to operate pure jets and the first (and so far the only one) to use both turboprops and turbojets on a medium-haul route network. The first Comet services, from New York to Chicago and Washington to Chicago, are scheduled to start on January 1, 1959; there is also the possibility that Comets may operate services to San Juan, Puerto Rico. The implications of this order have already been examined in some detail in *Flight*, particularly in the August 17, 1956, issue; but it is worth recalling these words of Mr. Carmichael's: "We feel that, despite the Comet 1 problems [the Comet 4] is the best-tested and safest aircraft in the world. . . . The analysis we made of the Comet from an economic and operational viewpoint was far more detailed than even with the Viscount."

An even finer tribute to Vickers, de Havillands and Rolls-Royce comes from Mr. J. B. Franklin: "We at Capital are sold on turbine-powered transports. We know from experience that they do not present any insuperable operating and maintenance problems, that they offer greater reliability, safety and economy and that the travelling public demands them. What more could you ask?"

CAPITAL AIRLINES OPERATING STATISTICS

Year	Net profit or loss (dollars)	Revenue Miles Flown	Revenue Passengers Carried	Revenue Passenger-Miles	Total Revenue Short-Ton Miles	Total Route Mileage
1945	535,000	n.a.	n.a.	n.a.	n.a.	n.a.
1946	–2,118,000	17,692,000	1,342,000	373,381,000	n.a.	3,989
1947	–1,114,000	n.a.	n.a.	n.a.	n.a.	n.a.
1948	626,000	17,532,000	1,021,899	275,770,000	34,169,071	5,409
1949	2,051,000	20,747,000	1,215,672	280,348,000	44,817,023	5,190
1950	1,418,000	21,611,000	1,405,814	429,729,000	53,530,277	5,190
1951	1,907,000	25,576,000	1,951,356	625,262,000	68,670,412	5,190
1952	1,537,000	26,308,000	2,011,264	637,579,000	69,338,107	5,190
1953	1,829,000	28,802,000	2,248,998	716,607,000	77,911,651	5,500
1554	1,536,000	29,845,000	2,426,961	756,240,000	83,679,624	5,500
1955	4,562,276	31,215,000	2,570,170	803,923,000	86,927,252	6,220
1956	–1,795,269	n.a.	2,984,410	1,021,564,000	106,817,136	n.a.

JAPANESE PRODUCTION STEP-UP

IN Tokio this month the United States and Japan signed an agreement under which Japan will produce more jet aircraft for its air force. The documents signed, revising an agreement of April last year, provide: (1) The Shin Mitsubishi Heavy Industries Corporation, originally due to produce 180 F-86 Sabres for the Japanese Air Force by June 1958, will produce 300 by September 1959. (2) The Kawasaki Aircraft Company, originally due to provide 180 T-33 trainers by June 1958, will turn out 210 by December 1958.

1957 TOUR OF SICILY

ONE of the best-known Continental air rallies, the Italian Tour de Sicile, is to be held this year from June 22 to 26. This will coincide with the 50th Congress of the F.A.I., also in Sicily. The entry fee is 5,000 Italian Lire (about £2 18s) after which all fuel, oil, hangarage and accommodation for pilots and passengers will be provided free of charge. The host of the tour is Cmdt. Giuseppe Albanese, who is president of the Aero Club of Sicily.

On Friday, June 22, participants will foregather at Palermo and spend the night in the famous Hotel Igea. On the following morning, the first stage of the trial is to be flown—to a handicap formula—round the southern coast of Sicily to Catania. After a formal lunch there, the competitors are to be taken by bus to Taormina for a day at the Hotel San Domenico. On the Sunday afternoon the second stage is to be flown, along the north coast and back to Palermo. The Monday will be given up to sightseeing and the rally finishes on the Tuesday morning. The prizes are to be presented to those successful in the handicap competitions, which are arranged mainly for the aircraft of high performance. Competitors who arrive with less refined touring aircraft are not greatly involved in the handicap flights. The organizers are anxious to welcome as many foreign participants as possible, and particularly those from Britain.

FOR CYBERNETICISTS

WITH headquarters at 13, Rue Basse-Marcelle, Namur, Belgium, an "International Society for Cybernetics" has been formed under the presidency of M. Georges R. Boulanger, professor of the Polytechnic Faculty at Mons and of Brussels University. Other committee members are M. René Close (Belgium), M. Louis Couffignal (France), Mr. John Diebold (U.S.A.) and Mr. Grey Walter (U.K.). The executive secretary is M. Josse Lemaire.

Cybernetics can be defined as the study of control mechanisms in machines and living creatures. A book on the subject by Mr. Diebold, the American member of the committee, is thought to be the most important work on automation yet published.

The formation of an international society was decided upon at the first international congress on cybernetics held at Namur last June. The Society was actually brought into being earlier this year and already numbers over 1,000 members—some 300 of whom are commercial concerns—drawn from 26 countries. Principal objective of the new body is to assure permanent and organized liaison between those people and agencies in various countries engaged in work on cybernetics and associated fields. The Society aims to promote the development of the science and to publish the results of researches

THE HAWK'S TALONS

As a portrait of a Hawker (Armstrong Whitworth) Sea Hawk, to illustrate our special Fleet Air Arm issue of March 22, we printed a "Flight" photograph of an FGA.6 of No. 803 Squadron armed with two 500 lb bombs and sixteen rocket projectiles. We now depict the same aircraft at the very instant of releasing its bombs (above) and its R.P.s (below).

"Flight" photographs

The Aerfer Sagittario 2 during a recent public demonstration.

Italian Industry

A Summary of Current Production and Planning

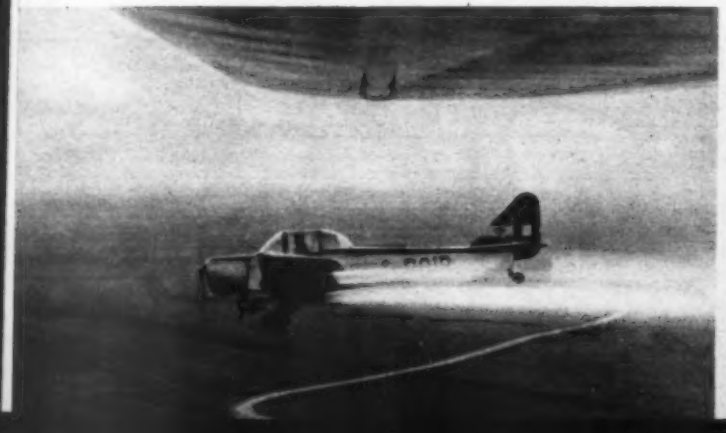
SINCE World War 2 the Italian Government has not given its aircraft industry a great deal of support or inspiration; and for this reason more firms have closed their doors than have remained in business. The survivors now make their own way and arrange their finances and administration so that they are independent of government orders. But it appears that this lack of official support cannot be blamed on the technical departments of the Italian Air Ministry, since these are themselves affected by it; they have nevertheless managed to produce highly efficient tactical wings for the Italian Air Force, as well as an effective nucleus of navigation and traffic-control facilities. The lack of State support has been blamed on the purely political sections of the government which, each year, allot only a very small budget to the country's military and industrial aviation activities.

The industry which has survived, and the active Air Force units which now exist, quantitatively represent but a small proportion of Italy's aviation potential. It is nevertheless claimed that the quality of these companies and units represents an asset of considerable prestige-value to Italy.

The principal firms now engaged in aircraft and engine manufacture are Fiat, Aerfer, Piaggio, Macchi, Agusta, Siai Marchetti, Aviamilano, Pasotti, Nardi, and Partenavia. Of these Fiat (a detailed description of whose work appeared in *Flight* on January 25) is the largest. The various divisions of the Fiat aeronautical concern are working well below their full capacity but are engaged in the manufacture of advanced aircraft and engines. Equipment and installations are well up to date and Fiat have supplied to the Italian Air Force a small batch of G.82 jet trainers and construction is continuing on the 30 G.91 light tactical fighters for NATO. Also for NATO countries the company is producing North American F-86Ks. Licences are in hand for production of major jet-engine sub-assemblies and complete turbojets; and the company carries out a good deal of aircraft and engine overhaul work.

Aerfer is part of an industrial group set up with the assistance of public capital and working for the Air Force. The factory at Naples is very well equipped for metal working and has turned out parts for both F-84G and F-84F. The company is developing the Sagittario light fighter, originally designed by the Ambrosini company. This machine is to be followed by the Ariete, a light intercepter (which is reported to figure in a NATO programme) and, later, by the Leone, a mixed-power intercepter.

(Below) the Meteor FL.55 crop sprayer and (right) the very fast little Partenavia Tornado two-seater competition machine.



The prototype Sagittario 2 has now exceeded Mach 1 in a dive.

Piaggio are in the final design stage with the P.155 amphibian. Their main successes hitherto have been the P.149 trainer and touring aircraft, the licence for which has been bought for the German Air Force; and the P.136 amphibian, which is used by the Italian Air Force for training and air/sea rescue and is also exported as an executive aircraft to the U.S.A. Piaggio mainly owe their present prosperity to the export orders and licence agreements which they have negotiated on their own initiative.

Macchi have a great tradition going back to their Schneider Cup-winning aircraft of 1926 and to the World War 2 fighters, the MC.200, 202 and 205. Since the war, the company has produced the little MB.308 and the MB.320 6-seat executive twin. In the military field, Macchi have built Fokker S.11 primary trainers and numbers of D.H. Vampires for the Italian Air Force; some of the latter have now been sold abroad. The MB.326 Viper-powered all-metal trainer, which is in the Fouga Magister and Hunting Percival Jet Provost class, is now being prepared; and the prototype should fly by the end of the year. Macchi also overhaul T-33s for the Italian Air Force.

Agusta is a well-equipped private company which, by producing the Bell 47 helicopter under licence, has achieved considerable commercial success and still retains its pride of place as the only Italian constructor of rotary-winged aircraft. The Bell 47s have been sold to the Italian Air Force, to some of the municipal fire services, and to the Customs and Excise services, as well as to the French Air Force and to civil customers in Algeria and in many other countries. Agusta are at present building the Bell 47G two-seater and the 47J five-seater in numbers. In addition, the company is studying a Bell 7-seater, presumably a variant of the XH-40, and preparing a 15-seater helicopter designed by Ing. Zappata. This is a single-engined, single-rotor machine in which the Italian Air Ministry has shown an interest, but construction is at present held up by the lack of a suitable engine.

Agusta are also entering the fixed-wing field and, after abandoning a twin-engined design called AZ.1, are completing construction of three prototypes of a medium-size four-engined passenger aircraft, called AZ.8L, and also designed by Ing. Zappata. The AZ.8L might be said to fall into the DC-3 replacement category.

Siai Marchetti are mainly engaged in the overhaul of American aircraft in Europe, particularly of Fairchild C-119s for the Italian Air Force; but a 20-seat civil aircraft powered by four turboprops and called the Aldebaran is being designed. A pure-jet version of this machine is also foreseen. Marchetti designed and built the Eolo high-performance sailplane which competed in last year's world gliding championships in France.

Aviamilano is a small new company, but it has achieved a world-wide success by its production in some numbers of the Falco F.8L designed by Ing. Stelio Frati. Soon the company will also fly a four-seat version of the Falco, called the Nibbio F.14 and powered by a 180 h.p. engine. The Nibbio's place in the experimental shop will be taken by a small two-seat jet aircraft for club flying and basic training.

Pasotti are completing certification tests of the twin engined F.6 Airone and flight-testing of the F.9 Sparviero, which is a single-engined version of the Airone powered by a Hirth engine giving 240 h.p. Only the Airone is to be put into production.

The small Meteor company has already achieved considerable success with the FL-53, 54 and 55 glider tug, touring and agricultural aircraft. Numbers of these machines have been sold in Switzerland for mountain rescue work.

The Nardi company is carrying out flight tests of the FN.333 single-engined, twin-boom pusher amphibian, the prototypes of which are being built by Fiat. The Partenavia concern, based in Naples, is preparing another example of the Tornado, a brief flight in which was described in our report of the Venice light aircraft show in *Flight*, August 10, 1956. This very fast little aircraft won the tour of Sicily last year. Finally, Col. Mario De Bernardi is completing flight tests of the intriguing tiny all-metal Aerscooter. This little machine may, in due course, be fitted with an autogiro rotor to allow near-vertical landing and take-off. A two-seater version may also be developed later.

HISTORIC MILITARY AIRCRAFT No. 16 (Pt. II)

THE SOPWITH TRIPLANE

By J. M. BRUCE, M.A.

THE Sopwith Triplane became operational in time to participate in the Battle of Arras, which opened on April 9, 1917. No. 1 (Naval) Sqn. had spent several weeks in gunnery practice and formation flying on their new mounts, and made their first offensive patrol early in April. That patrol was uneventful, but on the following day Flt. Cdr. R. S. Dallas shot down an Albatros, and next day he, F/L. Clayton and Flt. Sub-Lt. T. G. Culling each shot down an enemy aircraft.

Naval Eight also proved the Triplane's quality at the beginning of April 1917, a month which was to witness aerial fighting of a new intensity: during that "Bloody April," the R.F.C. suffered its heaviest casualties of the war. F/L. R. A. Little had quickly found confidence in the Triplane, for on April 7 he fought a magnificent action which is best described in the words of eye-witnesses in the 3rd Army's Anti-Aircraft Artillery Group:

"At 6.45 p.m. on April 7th, 1917, a Sopwith Triplane, working alone, attacked eleven hostile machines, almost all Albatros Scouts, N.E. of Arras. He completely outclassed the whole patrol of hostile machines, diving through them and climbing above them. One Albatros Scout, painted red, which had been particularly noticed by this section, dived on to him and passed him. The Sopwith dived on him and then easily climbed again above the whole patrol, drawing them all the time towards the anti-aircraft guns. As soon as they were in range, the anti-aircraft guns opened fire on the patrol, which turned eastward, and the Sopwith returned safely. The officers who witnessed the combat report that the manœuvring of the Sopwith Triplane completely outclassed that of the Albatros Scout."

The Germans did not altogether agree with that opinion, for their official notes on the Triplane aver that it was slower in the dive than corresponding German types but superior in climbing ability, especially at altitude, and that it was comparable to the Pfalz D.III and Albatros Scout in terms of manœuvrability. The German combat notes may have been designed to maintain the morale of their pilots, for they stated that the Triplane was liable to break up if subjected to violent manœuvres and avoided dog-fighting, depending on its remarkable climbing ability to extricate itself easily from any battle of turns. The notes conclude with the splendid platitude: "If it dives away it can be shot down with ease."

THE author acknowledges with gratitude the assistance he has received from Mr. A. R. Weyl, A.F.R.Ae.S., A.F.I.A.S., F.B.I.S., who lent material from his collection; from Mr. Bruce Robertson, who again provided the blocks of serial numbers and other information; and from Mr. H. H. Russell, who provided notes on individual machines.

The R.N.A.S. pilots could hardly have known of the official German opinion of the Triplane, but they lost no opportunity to demonstrate its superiority in combat, and must have made many an enemy pilot question the accuracy of his combat notes. So far from avoiding combat, the Naval Triplanes soon established themselves as formidable and dreaded opponents—in Vol. III (page 364) of *The War in the Air*, H. A. Jones recorded this tribute to the Triplanes' work in the Battle of Arras:

"The three Naval squadrons, Nos. 1, 3 and 8, were continuously engaged, but were given few opportunities to drive home their attacks. The sight of a Sopwith Triplane formation, in particular, induced the enemy pilots to dive out of range."

On April 21, 1917, two Triplanes of No. 1 (Naval) Sqn. fought one of the war's great aerial actions. The aircraft were flown by Flt. Cdr. R. S. Dallas and Flt. Sub-Lt. T. G. Culling who, after inconclusive brushes with enemy two-seaters, attacked a German formation of fourteen two-seaters and single-seat fighters which were flying towards the lines at 16,000ft, obviously bound on an important mission. Their task was never accomplished, for the two Triplanes harried them for 45 minutes, broke up their formation, shot three of them down, and finally drove the remainder ignominiously downwards and eastwards. In this combat the Triplanes' excellent climbing ability gave them an immense tactical advantage.

Eight days later, six Triplanes of Naval One were too late to save Maj. H. D. Harvey-Kelly and two of his pilots who, flying Spads of No. 19 Sqn., R.F.C., had unhesitatingly attacked a formation of 11 Albatros D.IIIs led by Manfred von Richthofen. The three Spads fell just before the Triplanes arrived and engaged the enemy fighters, of which they sent three down out of control. That combat is of interest, in view of the historical link between the R.F.C. Spads and the R.N.A.S. Triplanes.

In nine days between April 22 and May 5, 1917, No. 1 (Naval) Sqn. mounted 95 offensive patrols, in the course of which 175 enemy aircraft were engaged. Four of these were destroyed and twelve others sent down out of control.

These actions could not have been fought by men who lacked confidence in the structural strength of their aircraft, nor could they have been so pugnaciously undertaken by aircraft which ". . . . avoids, as far as possible, any excessive demands upon itself, for it breaks up easily . . . and, after an unsuccessful attack, generally avoids a battle of turns."*

No. 10 (Naval) Sqn. had flown its Sopwith Triplanes on escort duties from St. Pol, and was moved to Furnes in April 1917. In the

**From the German official report.*

In the heading picture is N.5912, the sole remaining Triplane. On the left is a Triplane with twin Vickers guns.

Triplane N.509 (150 h.p. Hispano-Suiza engine) leaving the Sopwith works. Above, N.509 assembled.

THE SOPWITH TRIPLANE . . .

middle of the following month Naval Ten was attached to the R.F.C. as a reinforcement to the Eleventh Army Wing in the Second Army area; the unit was followed by Naval One on June 1. Both squadrons had 15 Sopwith Triplanes on strength at that time: a shortage of pilots had necessitated the reduction of the units' establishments from 18 to 15 aircraft.

From Arras (which, thanks to the failure of the French offensive on the Aisne, was but a limited success) the war had progressed to the preparations for transferring the main Allied effort to the British front in Flanders. As a preliminary, it was considered essential to capture the hills which formed the Messines-Wytschaete ridge. The moves of R.N.A.S. squadrons Nos. 1 and 10 were part of the British preparations for the Battle of Messines; the main preparatory bombardment began on May 31, 1917, and the battle opened on June 7.

The bombardment inevitably led to intense aerial activity, and the Sopwith Triplanes of Nos. 1 and 10 (Naval) Sqns. were in frequent action. In the morning of June 6 those of Naval One had many successful fights. Thirteen Triplanes of Naval Ten attacked 15 German machines, some of which were two-seaters bound for the British lines, over Ploegsteert Wood. The enemy formation was utterly defeated: five of their number were shot down, two of them Albatros fighters which fell in flames as victims of Flt. Sub-Lt. Raymond Collishaw.

Collishaw was, without doubt, the most brilliant exponent of the Sopwith Triplane. He had come to Naval Ten on April 1, 1917, as commander of "B" Flight; his earlier operational flying had been with No. 3 Wing (with which he shot down three Fokkers) and with No. 3 (Naval) Sqn., in which unit he shot down an Albatros D.III. He had shot down three enemy fighters and a seaplane between April 1 and May 15, 1917, when Naval Ten joined the R.F.C.

A Canadian himself, Collishaw had a Flight which was exclusively Canadian and one of the most formidable fighting units to take the air during the 1914-18 War. Between May and July, 1917, "B" Flight of Naval Ten destroyed a total of 87 enemy aircraft. In a period of 27 days in June 1917, Collishaw himself shot down 16 enemy aircraft, all but three of which were single-seat fighters. The original members of "B" Flight were Flt. Sub-Lts. E. V. Reid, J. E. Sharman, G. E. Nash and W. M. Alexander: their contributions to the Flight's total of 87 enemy aircraft in three months were respectively eighteen, eleven, eight and seven.

Naval Ten's "B" Flight was known as the "Black Flight," for its aircraft bore the names *Black Death*, *Black Maria*, *Black Roger*, *Black Prince* and *Black Sheep*. Popular legend has it that the Triplanes were painted all black, but it seems more probable that the colour was confined to the engine cowlings and the aluminium panels at the noses of the aircraft. It is known that the members of the Black Flight flew the following Triplanes (but it does not follow that each officer flew the specified aircraft exclusively): Collishaw, N.5490 and N.5492; Reid, N.5483; Sharman, N.6307; Alexander, N.5487.

The Black Flight suffered its first casualty on June 26, 1917, when Nash was wounded and forced to land behind the enemy lines. His conqueror was Lieutenant Allmenröder, one of the leading German fighter pilots, who had 30 victories in air combat. Collishaw did not, of course, know the German pilot's identity, but next morning he and his Flight attacked seven enemy fighters over Courtrai, and he recognized one of them as the green-tailed Albatros which had defeated Nash. In the fight which ensued. Collishaw shot down and killed Allmenröder; the Albatros crashed in the outskirts of Lille. Three other enemy fighters fell to the Black Flight in that combat.

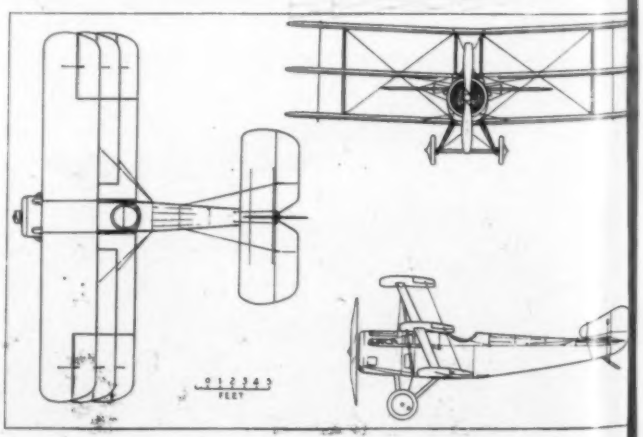
Four of Naval Ten's Triplanes played a gallant part in the combat in which Manfred von Richthofen was shot down wounded by 2nd Lt. A. E. Woodbridge, the observer of one of six F.E.2Ds which had been attacked by the German leader and 39 other enemy fighters. The Triplanes went to the rescue of the F.E.s, heedless of the odds; they shot down four of the enemy out of control, but were unable to save two of the pushers from defeat. Their unhesitating attack on the large enemy formation, which consisted wholly of single-seat fighters, makes an instructive contrast with Richthofen's technique of attacking slower, less manœuvrable aircraft with a vastly superior force.

The Triplanes gave excellent service in the battles of Ypres, but they began to be withdrawn in the summer of 1917. Camels began to replace the Triplanes of Nos. 8 and 9 (Naval) Sqns. in July, and by August 4, No. 9's re-equipment was complete. Naval Ten began to receive Camels at the end of August, when three of its Triplanes were transferred to No. 1 (Naval) Sqn. to restore that unit's strength to 18 aircraft. Naval One's attachment to the R.F.C. ceased in November 1917, and the unit returned to Dover to be re-equipped with Camels.

The passing of the Triplane was regretted by many of those who had had the good fortune to fly it. As a fighter, it enjoyed the distinction of never having been outclassed. No doubt the real reason for its withdrawal lay in the statement that even minor accidents to a Triplane necessitated a disproportionate amount of repair work. If that were true, maintenance in the field must have been a time-consuming process, and serviceability may have been relatively low. It has also been said that the Triplane was more difficult to rig than contemporary biplanes.

It had the Pup's disadvantage of having only one gun; though even that was overcome. The six machines N.533-N.538 were built with twin guns by Clayton and Shuttleworth; of these at least two, N.533 and N.534, saw operational use with Nos. 10 and 1 (Naval) Sqns. respectively. The batch ordered from Oakley were to have been similarly armed, but the contractor was new to aircraft manufacture and, as noted in Part 1, the third Oakley-built machine was not delivered until October 19, 1917, by which time the Camel had been standardized and only Naval One still had Triplanes. No further Triplanes were completed by the Oakley concern.

Despite the disparaging combat notes on the Triplane issued by the German authorities, there is a good deal of evidence to indicate that the Sopwith caused the enemy a great deal of anxiety. It seems that two of the first Triplanes to go to France shared the same fate as early F.E.2Ds and the Handley Page O/100, for it has been said that their pilots lost their bearings and landed on an enemy aerodrome. The truth of this is hard to establish, but at least one Triplane fell into enemy hands intact, or nearly so, for it was flown in German markings. This particular machine did not have the standard shape of fin: the surface with which it was fitted had the same outline as the fin of the Sopwith 1½-Strutter. It is not known whether the fin was a manufacturer's experiment or a squadron or pilot's modification: as far as is known, it was not



a modification or replacement made by the Germans. The Triplane concerned had the original large tailplane.

The German fighter experts were greatly impressed by the Sopwith. Manfred von Richthofen himself stated that the Triplane was the best British aircraft then in service and that, in comparison with British biplane fighters, it was fast, more manœuvrable, maintained its height in turns, climbed better, and could be dived vertically. It appears that von Richthofen's opinion was based on combat experience and observation, for there is no record that he flew a Sopwith Triplane.

Perhaps the greatest compliment the enemy paid the Triplane was the appearance, in rapid profusion, of an astonishing number of German and Austrian triplane single-seat fighters, soon after the Sopwith machine proved its mettle. Triplanes were not altogether new in Germany: an Euler triplane (and doubtless others) had flown before the war, and the German aircraft industry had a number of designers who favoured triplanes. It seems, however, that that favour stemmed from structural considerations rather than from operational requirements. A few German triplanes appeared as early as 1915, but were not accepted for service.

The Sopwith Triplane's remarkable success, endorsed by von Richthofen, was not lost upon Hauptmann Kurt Schwarzenberger, who was in charge of operational flight testing at Adlershof. He suggested that German designers should follow the Sopwith example and produce fighters of triplane configuration. There followed a remarkable number of triplane single-seat fighters. The A.E.G., Albatros, Brandenburg, D.F.W., Euler, Fokker, Pfalz, Roland and Schütte-Lanz companies all produced single-engined, single-seat triplanes: the Sablatnig company built a triplane version of their SF-4 seaplane fighter; and the Siemens-Schuckert Werke produced the most extraordinary triplane of all, powered by two Siemens-Halske rotary motors installed one at the nose and the other at the tail of the central nacelle. Austrian manufacturers followed suit, and triplanes were built by the Austrian Aviatik, Lohner, Oeffag and W.K.F. concerns. A triplane version of the Brandenburg CC single-seat flying-boat fighter also appeared.

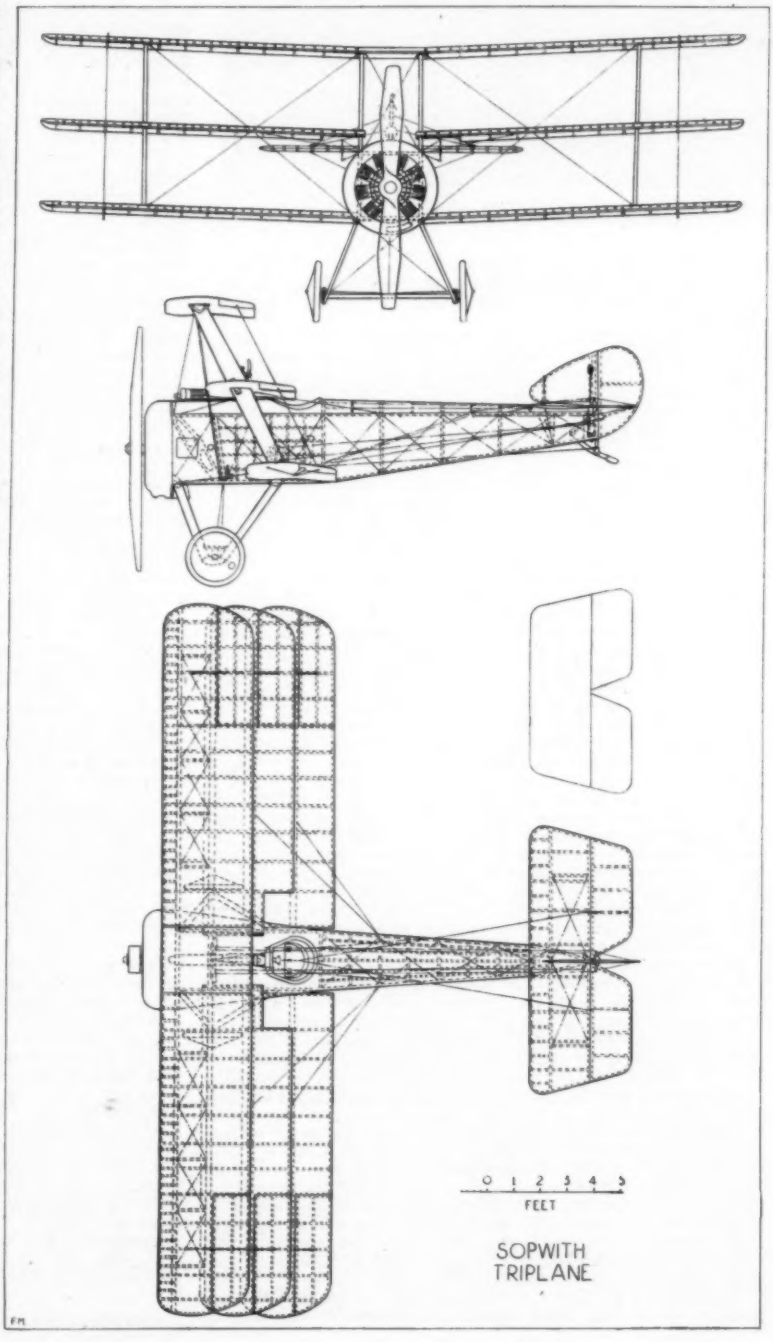
Of all these types, only the Fokker V4 triplane went into production, as a Fokker Dr.I (properly, Fok. Dr.I); the Pfalz Dr.I was produced in small numbers, but the greatest number in operational use was only nine. That was in June 1918, when 171 Fok. Dr.Is were operational.

It has been said that Fokker contrived to have the remains of a shot-down Sopwith Triplane sent to his factory instead of to their proper destination, the experimental station at Adlershof. Whatever the truth of that story may be, the Fokker V4 which was designed by Reinhold Platz was a completely different aircraft from the Sopwith machine: all that the two aircraft had in common was the triplane configuration. For propaganda purposes at the time, as with the alleged Handley Page/Gotha development, it was asserted that the Fokker triplane was a copy of the Sopwith; and a natural post-war desire to uphold national prestige came close to perpetuating that misconception (for misconception it unquestionably was). The first Fokker Dr.Is in service were at the front in July 1917, but the type was not formally adopted until November of that year. It, more than the Sopwith Triplane, suffered from structural weakness.

Our allies were quite as interested as the enemy in the Sopwith Triplane. At least four were transferred to the French government, presumably for evaluation with a view to production of the type in France. These Triplanes were N.5384, N.5385, N.5386 and N.5388, of which the second and fourth are known to have had the 110 h.p. Clerget. Triplanes returned from the French were numbered N.524, N.541, N.542 and N.543, but it is not known whether any or all of those numbers were allotted to the four machines mentioned above.

At least one Sopwith Triplane, N.5458, went to America. There it was exhibited, probably as a veteran combat aircraft, for it had served with Nos. 8 and 10 (Naval) Sqns.; equally probably, it may have been tested by American pilots. Another example, N.5486, left the White City depot on May 4, 1917, bound for Russia, but no records of its subsequent history seem to have survived to the present day.

Only one Triplane, N.5431, was used outside the Western theatre of war. Early in 1917 this machine was sent to No. 2 Wing, R.N.A.S., at Mudros on the island of Lemnos in the Aegean



The general-arrangement drawing on the left shows N.509 (150 h.p. Hispano-Suiza engine). The large drawing to the right shows a typical production Triplane, with the small (earlier) tailplane shown as a detail.

The second Hispano-Suiza-powered Triplane—No. N.510.

THE SOPWITH TRIPLANE . . .

Sea. The fact that it was there in March 1917, before a Triplane squadron was fully operational in France, probably indicates that it had been sent out to test its suitability for service in the Aegean area.

To combat the threat of *Kampfgeschwader I*, the German bombing squadron which had arrived at Hudova in February 1917, an R.N.A.S. unit known as "E" Squadron was formed in March. Its equipment consisted of four Sopwith 1½-Strutters and the Triplane N.5431, and it was to form part of a composite R.N.A.S./R.F.C. fighting squadron at Hadzi Junas. The five aircraft of "E" Sqn. went to Hadzi Junas by way of Stavros and Salonika, and the Triplane was flown by F/L. J. W. Alcock (who was later to make the first non-stop transatlantic flight). At Salonika, Alcock unfortunately over-ran the small aerodrome: his Triplane ran into a shallow ditch, overturned, and was extensively damaged.

The wreckage was taken back to Mudros, where the aircraft was rebuilt and returned to service, still under the identity of N.5431, although little of the original airframe could have remained. The Triplane was reported in action on September 30, 1917, when, flown by F/L. H. T. Mellings, it shot down one of three enemy seaplanes which approached Mudros. The enemy force consisted of a two-seater escorted by two single-seaters, the latter being of a type known to the R.N.A.S. as "Blue Birds"—almost certainly Albatros W.4s. Mellings shot down one of the "Blue Birds"; the other was driven down by Alcock, who was flying a Camel.

Alcock had spent September of 1917 building a remarkable hybrid aircraft of his own design. It was a single-seat fighter which embodied components of Sopwith Triplane and Pup origin; Alcock, with typical humour, dubbed it his "Sopwith Mouse," and it appears that his machine was also known as the Alcock A.1. The entire forward portion of the fuselage and the undercarriage had belonged to a Sopwith Triplane; the rear portion of the fuselage tapered to a vertical knife-edge at the rudder post, and two low-aspect-ratio triangular fin surfaces were fitted, one above, the other below, the fuselage. The rudder could have been of Sopwith outline, and the tailplane was mounted midway between the longerons. The lower wing was that of a Sopwith Triplane; the upper wing panels had originally belonged to a Pup, and the centre section was mounted fairly close to the fuselage, level with the pilot's eyes. Two-bay bracing was fitted: the interplane struts diverged markedly from the closely-spaced spars of the lower wing to meet the spars of the much broader upper mainplane.

Alcock's "Sopwith Mouse" was originally fitted with a 100 h.p. Gnôme Monosoupape engine, but that was later replaced by a 110 h.p. Clerget. Twin Vickers guns were fitted in the conventional position, and the aircraft had excellent lines and bade fair to be a useful fighter.

Unfortunately, Alcock fell into the hands of the enemy on the night of September 30 when No. 2 Wing's Handley Page O/100, Constantinople-bound, was forced down in the Gulf of Xeros with engine failure. Alcock was the pilot, and he and his crew were captured. He therefore never flew his Sopwith Mouse, and it is believed that the machine did not fly until the middle of October. It is not known whether it was ever used operationally, but it survived until early 1918, when it was flown to Stavros on the mainland. As far as is known, it was wrecked there.

That is the true history of the Alcock A.1 or Sopwith Mouse. It differs widely from the account which appears in *The War in the Air*, Vol. V, page 409, where it is stated that Alcock had designed and built an aircraft round a German Benz engine which had been retrieved intact from a twin-engined Friedrichshafen bomber shot down in April 1917. The official history goes on to imply that Alcock was flying this Benz-engined aircraft on September 30 when he shot down the "Blue Bird." It is possible that Alcock, a fine engineer, may have modified some other existing type of aircraft to take the Benz and this may have led to confusion with his own aircraft. There is some evidence to suggest that a Benz engine was installed in one of the Wight pusher seaplanes of the aircraft carrier *Ark Royal*, but the engine in question was taken from a Friedrichshafen seaplane which had been brought down in July.

The Clerget-powered Triplane was not the only Sopwith single-seat fighter to employ the triplane configuration. It was closely followed by another design of which two examples were built: the first, N.509, had a 150 h.p. Hispano-Suiza engine; the other, N.510, had a 200 h.p. Hispano-Suiza. Some references to these triplanes imply that they were merely developments of the Clerget-powered machines. That is not so. The Hispano-Suiza triplane was a completely different aircraft which owed far more to the 1½-Strutter than to the Pup or Clerget Triplane: its tail unit was virtually identical to that of the 1½-Strutter.

The interplane bracing of N.509 and N.510 was identical to that of the Clerget Triplane, but the mainplanes were of greater chord (4ft 3in) and area. Detail differences existed between the two Hispano-powered machines, but N.510 could be positively identified by its higher thrust-line and left-handed propeller; it also had a different fuel system. Both aircraft were equipped with a circular frontal radiator.

The Hispano-Suiza triplane did not go into production, possibly because all Hispano-Suiza engines were wanted for the S.E.5s then going into production. The Service careers of N.509 and N.510 are not well documented. The former was at Westgate in March 1917, but apparently went from there to Manston, where it was written off after fair wear and tear on October 29, 1917; thus the 150 h.p. triplane outlived N.510, which was at Eastchurch in December 1916, but crashed in the course of its trials there. Its pilot, Lt. Hardstaffe, was killed; he had been one of the first Service pilots to fly N.500, the first Sopwith triplane of all.

Later triplanes built by the Sopwith company were the big three-seat L.R.T.Tr. escort fighter, the ugly Rhino two-seat bomber, and the twin-engined Cobham bomber. This last type was preceded by a single-seat fighter triplane, the Snark. The Snark had a wooden monocoque fuselage and was specifically designed for high-altitude fighting. It could carry as many as six machine-guns, the normal twin Vickers being supplemented by four Lewis, two under each bottom wing. The interplane bracing was more conventional than in the Clerget or Hispano-Suiza triplanes, but the stagger was not constant. According to Oliver Stewart, the Snark, "although it possessed a better performance and was a satisfying aeroplane to fly, did not achieve the supreme handling excellence of the earlier model." The Snark was too late to be considered for Service use, but it was in any event foredoomed to failure, for its engine was the ill-starred A.B.C. Dragonfly.

It is recorded in *The War in the Air* that the original Sopwith Pup and Triplane both survived the war. As far as the Triplane is concerned, that statement is incorrect, for N.500 was written off at Dunkerque after fair wear and tear, on December 17, 1917. Certainly, no Triplanes remained on the R.A.F.'s strength at the time of the Armistice. One alone has survived—N.5912, the third and last Oakley-built Triplane. It flew at the 1936 Hendon Display, by which time it had acquired additional mid-bay flying wires to the spars of the top wing. *Flight* reported: "The performance of the old triplane was something of a revelation; its take-off and climb were surprisingly good, and reminded one that, when it first came out, this type was rather remarkable."

Rather remarkable. The insertion of the somewhat patronizing "rather" was perhaps excusable, for the Triplane, although well enough known as one of the British fighters of the First World War, has been neglected by historians and has not been appreciated at its true worth. In their brief period of operational service, the comparatively few Triplanes destroyed a great number of enemy aircraft and obviously gave the Germans considerable cause for anxiety.

Considered as a form of military aeroplane, the triplane was peculiar to the 1914-18 war, for no serious triplane developments appeared in later years. Of the triplane fighters, the greatest were unquestionably the Sopwith and the Fokker; from the standpoint of all-round flying excellence the Sopwith was probably the better of the two. "It was so beautifully balanced, so well-mannered, so feather-light on the stick . . ." It was, in short, rather remarkable.

(Sopwith Triplane specifications and other data are given on p. 557.)

THE SOPWITH TRIPLANE . . .

SPECIFICATION AND SUMMARY

Powerplants.—110 h.p. Clerget; 130 h.p. Clerget. N.509: 150 h.p. Hispano-Suiza. N.510: 200 h.p. Hispano-Suiza.

Dimensions.—*Clerget Triplane:* Span, 26ft 6in; length, 18ft 10in; height, 10ft 6in; chord, 3ft 3in; gap, each 3ft; stagger, total 3ft; dihedral, 2 deg 30 min; incidence 2 deg; wing area, 231 sq ft. *Hispano-Suiza triplanes: Span*, 28ft 6in; length, 23ft 2in; chord, 4ft 3in; gap, each 3ft 6in; stagger, total 3ft; wing area, 340 sq ft.

Weights and Performance (130 h.p. Clerget Triplane).—Weight empty, 993 lb. Military load, 238 lb. Fuel and oil, 184 lb. Weight loaded, 1,415 lb. Maximum speed at 6,500ft, 116 m.p.h.; at 10,000ft, 114 m.p.h.; at 15,000ft, 105 m.p.h. Climb to 6,500ft, 6 min 20 sec; to 10,000ft, 10 min 30 sec; to 15,000ft, 19 min.

Manufacturers.—Sopwith Aviation Co., Ltd., Canbury Park Road, Kingston-on-Thames.

Other Contractors.—Clayton and Shuttleworth, Ltd., Lincoln; Oakley, Ltd., Ilford.

Production and Allocation.—No precise figures are available, but it is known that serial numbers were allotted for a total of 172 Sopwith Triplanes (Clerget), of which 22 were not built; four may have been renumbered on return from the French Government. Two Triplanes with Hispano-Suiza engines were built.

All the Triplanes were delivered to the R.N.A.S., and the large majority went to the Naval fighting squadrons in France. One was transferred to the R.F.C., four to the French Government and one to Russia; another was sent to America, in the autumn of 1917.

Armament.—One Vickers machine-gun mounted centrally on top of the fuselage in front of the cockpit, firing forward through the airscrew. Some Triplanes had twin Vickers guns.

Service Use.—*Western Front:* "A" Squadron, R.N.A.S., at Furnes; R.N.A.S. Squadrons Nos. 1, 8, 9, 10 and 12. *Aegean:* No. 2 Wing, R.N.A.S., Mudros. *Training:* War School, R.N.A.S., Manston; R.N.A.S., Port Victoria.

Serial Numbers.—N.500, N.504, N.524, built by Sopwith. N.533-N.538, built by Clayton and Shuttleworth, armed with two Vickers guns. N.541-N.543, N.5350-N.5389, built by Clayton and Shuttleworth. N.5420-N.5494, built by Sopwith. N.5910-N.5934, ordered from Oakley; only N.5910-N.5912 were completed. N.6290-N.6309, built by Sopwith. N.509-N.510, Hispano-Suiza Triplanes.

Notes on Individual Machines.*—N.500, first prototype, used by "A" Sqn. at Furnes, written off at Dunkerque on December 17, 1917. N.504, second prototype, at Brooklands August 26, 1916; written off (burnt) October 27, 1917. N.524, returned from French Government. N.533, used by No. 10 (Naval) Sqn., July-August 1917. N.534, No. 1 (Naval) Sqn. N.535, R.N.A.S., Manston. N.541-N.543; returned from French Government. N.5354, with No. 10 (Naval) Sqn. July-August 1917. N.5355, No. 10 (Naval) Sqn., July-August 1917. N.5359, No. 10 (Naval) Sqn., June 1917; flown by Flt. Sub-Lt. J. A. Page. N.5261, No. 12 (Naval) Sqn. N.5364, No. 1 (Naval) Sqn. N.5366 and N.5367, No. 10 (Naval) Sqn., July-August 1917. N.5368, No. 10 (Naval) Sqn., June 1917; Flt. Sub-Lt. O. S. Shirriff. N.5372, No. 1 (Naval) Sqn., July 1917; Flt. Sub-Lt. S. W. Rosevear. N.5373, No. 1 (Naval) Sqn., July 1917; Flt. Sub-Lt. C. G. Brock. N.5374, No. 9 (Naval) Sqn., June 13, 1917. N.5376, No. 10 (Naval) Sqn. N.5377, No. 1 (Naval) Sqn., also used by No. 9 (Naval) Sqn., July 1917. N.5378, No. 9 (Naval) Sqn., July 1917. N.5380 and N.5381, No. 10 (Naval) Sqn., July-August 1917. N.5382, R.N.A.S. Manston, July 7, 1917; Flt. Sub-Lt. Daly. N.5383, R.N.A.S. Manston. N.5384, N.5385, N.5386 and N.5388 were transferred to the French Government. N.5387, "15" of No. 1 (Naval) Sqn., Bailleul.

**The dates quoted against some serial numbers indicate only that it is known that the Triplane in question was with the squadron named at that date or period; the aircraft may have been with the squadron at an earlier date or over a longer period; it may also have served with other units. Similarly, mention of a pilot's name should not be taken to mean that the particular aircraft was flown only by that officer.*

N.5389, No. 10 (Naval) Sqn., July-August 1917. N.5420, supplied to Clayton and Shuttleworth as sample aircraft; later lost at Dunkerque. N.5421, No. 1 (Naval) Sqn., also used by No. 8 (Naval) Sqn., May-June 1917; Flt. Sub-Lt. F. V. Hall. N.5422, No. 1 (Naval) Sqn. N.5424, R.N.A.S. Manston, July 7, 1917; Flt. Sub-Lt. Butler. N.5425, "16" of No. 1 (Naval) Sqn. N.5426, No. 1 (Naval) Sqn., May-June 1917; Flt. Sub-Lt. H. K. Millward. N.5427, *Phillipine Island Britons No. 1*, used by No. 1 (Naval) Sqn., May-June 1917; Flt. Lt. F. H. M. Maynard. N.5428, No. 1 (Naval) Sqn. N.5429, No. 10 (Naval) Sqn., July-August 1917. N.5430, transferred to R.F.C. N.5431, No. 2 Wing, R.N.A.S., Mudros. N.5432, No. 1 (Naval) Sqn., May-July 1917; Flt. Lt. C. A. Eyre and Flt. Sub-Lt. de Wilde. N.5434, No. 8 (Naval) Sqn., May-June 1917; Flt. Sub-Lt. D. Shields. N.5435, No. 1 (Naval) Sqn., May-June 1917; Flt. Lt. C. A. Eyre.

N.5436, No. 1 Sqn., May-June 1917, Flt. Cdr. R. S. Dallas. N.5437, No. 1 Sqn., May-June 1917; Flt. Sub-Lt. D. W. Ramsey; with No. 10 Sqn., July-August 1917. N.5438, No. 1 Sqn., May-June 1917; Flt. Lt. C. A. Eyre. N.5440, *Britons in Siam No. 1*, used by No. 1 Sqn; Flt. Cdr. T. G. Culling; Flt. Sub-Lt. O. B. Ellis killed, May 19, 1917. N.5441, No. 1 Sqn. N.5442, No. 8 Sqn., May-June 1917; Flt. Sub-Lt. E. A. Bennetts. N.5443, No. 1 Sqn., May-June 1917; Flt. Sub-Lt. T. G. Culling. N.5444, *Canary Islands Britons*, used by No. 1 Sqn., May-June 1917; Flt. Cdr. B. C. Clayton and Flt. Sub-Lt. T. G. Culling. N.5445, No. 1 Sqn. N.5446, *Manaos Britons*, No. 1 Sqn., May-June 1917; Flt. Sub-Lt. R. P. Minifie. N.5447, No. 1 Sqn., May-June 1917; Flt. Sub-Lts. D. M. H. Wallace and B. C. Ridley. N.5449, No 8 Sqn., May-June 1917; Flt. Sub-Lt. P. A. Johnston. N.5450, No. 8 Sqn., May-June 1917; Flt. Lt. C. D. Booker. N.5451, No. 1 Sqn. N.5452, No. 1 Sqn., July 1917; Flt. Lt. B. C. Ridley. N.5453, No. 1 Sqn., July 1917; Flt. Sub-Lt. de Wilde.

N.5454, "1" of No. 1 Sqn. N.5455, No. 8 Sqn., also with No. 1 Sqn. in July 1917; Flt. Lt. Everitt. N.5458, No. 8 Sqn., also No. 10 Sqn., June 1917; Flt. Sub-Lt. D. F. Fitzgibbon; exhibited in America, December 1917. N.5459, No. 1 Sqn., also No. 9 Sqn., July 1917. N.5460, No. 8 Sqn.; Flt. Sub-Lt. J. J. Simpson. N.5461, No. 1 Sqn., Flt. Sub-Lt. G. G. Bowman killed, May 19, 1917. N.5462, No. 9 Sqn., July 1917. N.5464, No. 8 Sqn., also No. 10 Sqn., July-August 1917. N.5465, No. 8 Sqn., Flt. Lt. R. J. O. Compston. N.5466, No. 10 Sqn., June 1917; later to No. 1 Sqn., July 1917; Flt. Sub-Lt. S. W. Rosevear. N.5468, No. 8 Sqn., May-June 1917; Flt. Sub-Lt. Jenner-Parsons. N.5469, No. 8 Sqn. N.5471, No. 8 Sqn.; Flt. Sub-Lt. R. R. Thornely. N.5472, No. 8 Sqn., also "17" of No. 1 Sqn. N.5473, No. 1 Sqn., July 31, 1917. N.5474, No. 8 Sqn. N.5475, "18," No. 1 Sqn.; also with No. 9 Sqn., July 1917. N.5476, No. 1 Sqn. N.5477, No. 8 Sqn., May-June 1917; Flt. Sub-Lt. A. R. Knight. N.5478, No. 10 Sqn., June-August 1917; Flt. Sub-Lt. H. W. Taylor. N. 5479, *Britons in Spain No. 1*, "8" of No. 1 Sqn.; Flt. Sub-Lt. L. H. Cockey. N.5480, No. 1 Sqn., May-June 1917; Flt. Sub-Lt. D. W. Ramsey; later to No. 10 Sqn., July-August 1917.

N.5481, No. 8 Sqn., May-June 1917; Flt. Sub-Lt. H. A. Pailthorpe. N.5482, No. 8 Sqn., May-June 1917; Flt. Lt. C. D. Booker. N.5483, No. 10 Sqn., Flt. Sub-Lt. E. V. Reid, July-August 1917. N.5484, No. 1 Sqn., May-June 1917; Flt. Sub-Lt. J. F. Nalder; No. 9 Sqn., July 1917; No. 12 Sqn., September 1917. N.5485, No. 1 Sqn., July 1917; Flt. Sub-Lt. G. R. G. Scott. N.5486, sent to Russia, May 1917. N.5487, No. 10 Sqn., June-August 1917; Flt. Sub-Lt. W. M. Alexander. N.5488, No. 1 Sqn., May-June 1917; Flt. Cdr. T. F. N. Gerrard. N.5489, No. 9 Sqn., July 1917. N.5490, No. 1 Sqn., also with No. 10 Sqn., June 1917, flown by Flt. Cdr. R. Collishaw; later to No. 9 Sqn., July 1917. N.5491, No. 1 Sqn., May-June 1917; Flt. Cdr. R. S. Dallas. N.5492, No. 10 Sqn., June-August 1917; Flt. Cdr. R. Collishaw. N.5493, No. 8 Sqn., May-June 1917; Flt. Lt. R. A. Little. N.5494, *Peking Britons*, used by No. 1 Sqn. N.6290, No. 8 Sqn., May-June 1917; Flt. Lt. A. R. Arnold.

N.6291, used by both Nos. 1 and 8 Sqns. N.6292, No. 8 Sqn.; Flt. Sub-Lt. R. R. Soar; later to No. 1 Sqn. N.6295, No. 8 Sqn., May-June 1917; Flt. Lt. P. A. Johnston; later to No. 10 Sqn., July-August 1917. N.6296, *Britons in France No. 1*, used by No. 1 Sqn., May-July 1917; Flt. Sub-Lts. E. Anthony and G. R. G. Scott. N.6299, No. 1 Sqn., also No. 8 Sqn., May-June 1917; Flt. Lt. R. J. O. Compston. N.6300, No. 1 Sqn., May-July 1917; Flt. Cdr. F. H. M. Maynard, Flt. Sub-Lt. A. E. Spence. N.6301, No. 8 Sqn., May-June 1917; Flt. Sub-Lt. R. McDonald. N.6302, No. 10 Sqn., June-August 1917. N.6303, No. 1 Sqn., July 1917; Flt. Lt. R. P. Minifie. N.6304. No. 10 Sqn., No. 1 Sqn., July 1917; Flt. Lt. B. C. Ridley. N.6306, No. 10 Sqn.; Flt. Sub-Lt. L. H. Parker. N.6307, No 10 Sqn.; Flt. Sub-Lt. J. E. Sharman, July-August 1917. N.6308, No. 1 Sqn., July 1917; Flt. Lts. F. H. M. Maynard and H. V. Rowley. N.6309, No. 1 Sqn.

FORTHCOMING EVENTS

Apr. 29-May 4. Institute of Metals: Spring Meeting.
Apr. 30. R.Ae.S.: Section Lecture: "Purpose and Problems of Research Aircraft," by F. P. Youens, A.F.R.Ae.S.
May 4. British Interplanetary Society: Film Show.
May 4. Surrey Flying Club Anniversary.
May 4-5. Aero-Club des Greves du Mont Saint-Michel: Second International Rally, Avranches Aerodrome.
May 5. Tiger Club: Aerobatic Competition, Sywell.
May 8. R.Ae.S. Annual General Meeting.
May 9. R.Ae.S.: Main Lecture: First Lanchester Memorial Lecture, by Dr. T. von Karman, Hon.F.R.Ae.S.
May 10. Helicopter Association: "Military Helicopter Operations in Malaya," by W/C. W. R. Williams, O.B.E., D.F.C.
May 14. R.Ae.S.: Section Lecture: "New Techniques in Manufacture," by W. A. Baker, Grad.R.Ae.S.
May 15. R.Ae.S.: Graduates and Students Sections: "Guided Weapon Research and Development," by W. H. Stephens.
May 18. British Interplanetary Society: A.G.M. and Brains Trust.
May 18-20. Quiberon Aero Club: Air Rally and International Touring Meeting, Quiberon.
May 21-23. European Aircraft Ignition Conference (Champion Spark Plug Co.), London.
May 24-June 2. Paris Aero Show, Le Bourget.
May 25. Elstree Flying Club: At Home and Flying Display.
May 25-26. Popular Flying Association: Rally, Sywell.
May 28. R.Ae.S.: Section Lecture: "Flight Instruments," by F. W. Meredith, F.R.Ae.S.
May. 31-June 1. Aero Club of South Africa: Governor-General's Air Race.
June 1-2. Aero Club of Western France: International Rally, Anjou.
June 8-10. Fréjus-St. Raphael Aero Club: 4th International Rally, Fréjus.
June 9-10. Austrian Aero Club: International Rally, Vienna/Aspern.
June 9-16. Western France Aero Club: Angers Gliding Week, Angers.
June 10. Royal Aero Club: National Air Races First Round, and R.Ae.C. Aerobatic Competition, Yeadon.
June 10. Royal Dutch Aero Club: 6th International Air Display, Ypenburg.
Sept. 2-8. S.B.A.C. Show, Farnborough.

R.Ae.S. Branch Fixtures (to May 2):

May 1, *Leicester*, "Pioneers." by N. J. Capper; *Luton*, "Airbreathing Powerplants for Supersonic Flight," by A. W. Morley; *Weybridge*, Annual General Meeting; *Chester*, Annual General Meeting and Film Show. May 2, *Glasgow*, "Achievements and Prospects in the Field of Aircraft Engines," by Prof. A. D. Baxter.

THE AERONAUTICAL BOOKSHELF

"Famous Fighters of the Second World War," by William Green. Macdonald and Co., Ltd., 16 Maddox Street, London, W.1. Illustrated. Price 18s.

AN eighteen-shilling book devoted to the "biographies" of 18 World War II aircraft may sound rather on the expensive side; but never before have these particular types been written up so thoroughly and illustrated so fully. The result, therefore, is a work that will interest anyone who built, flew or serviced these aircraft; and it is, of course, a "must" for the enthusiast and model-maker.

The aircraft described are the Me 109, Hurricane, Spitfire, Bf (Me) 110, Curtiss P-40, Zero, Beaufighter, FW 190, Lightning, Mosquito, Thunderbolt, Mustang, Typhoon and Tempest, Kawasaki Hien, Kawanishi Shiden, Me 262 and Me 163 series. Typical of the thoroughness of treatment is that the chapter on the Me 109 runs to 12 pages, containing 25 photographs, 14 line drawings giving the side views of all major variants and a fine three-dimensional G.A. drawing by Gert Heumann.

Many of the photographs show little-known variants of unusual interest. There are few omissions, and these are mostly one-off rare birds such as the "Sunflower Seed" Hurricane and the Typhoon night fighter with A.I. equipment. J.W.R.T.

"Life in the Air Force To-Day." A young man's guide to all branches of the Royal Air Force. By G/C. E. C. Kidd. Cassell and Co., Ltd., 37/38 St. Andrew's Hill, London, E.C.4. Illustrated. Price 10s 6d.

THIS interesting and informative little book provides answers to practically every possible question about the R.A.F. within its 222 pages and half-a-dozen brief appendices. It has been written primarily with an eye on National Servicemen and, as Marshal of the R.A.F. Sir John Slessor points out in his foreword, may help to encourage some of them to make the Air Force their career or at least give them a more enjoyable two years' service by explaining "what it's all in aid of."

Sir John's foreword provides an admirable introduction, because he writes of the R.A.F.'s history from vast personal experience (and perhaps with an occasional slight nostalgia). Thus he contrasts the Vulcan with "the old Heyford or Whitley," the Hunter and Javelin with "the Gladiators and Gamecocks of the thirties"; speaks of the blue uniform which "has changed a bit since I first knew it" ("we used to wear breeches and puttees then and high collars to the tunic"); and recalls the R.A.F.'s inter-war service on the North-West Frontier, in Iraq, Jordan, the Persian Gulf and India. Underlying it all he stresses the idea of "service" as a fine thing for its own sake.

This makes a good start for G/C. Kidd's admirably down-to-earth and first-hand account (based again on long personal experience) of life in the Air Force today, covering every aspect in concise, sensible style and having (as the publishers point out in an authorized statement) the Air Ministry's complete approval. It should, of course, be added that the book was published just before the recent Defence White Paper radically altered the future outlook for the R.A.F. H. W.

"Vision," by Harold Mansfield. Duell, Sloan and Pearce, New York. Illustrated. Price $5.00.

THIS history of the trials and triumphs of the Boeing Airplane Company throughout its forty-year life is probably the finest book of its kind yet published. The author is Boeing's director of public relations; but this fact has not resulted in suppression of references to disappointments or setbacks, and only the harshest critic would regard *Vision* as anything but full, fair and frank, except for the familiar (but in this case unexpected) bleat that after the war Britain set up to "rival America's aircraft industry with government-supported jet transport development." This comment is all the more difficult to understand when one reads how vital were the KC-97 and KC-135 contracts to Boeing's civil transport programme.

How does one begin to review such a book in a few hundred words, when there is so much that is new and worth repeating? Some 96 Boeing types have been built in 40 years and most of them were interesting, including even the GA-X armoured ground-attack triplane of 1920 whose almost-deafened pilot asked after landing: "How can you attack the ground with an aeroplane you can't see out of, and that's too unwieldy to manoeuver close to the ground?"

Looking at the chart (forming the end-papers of the book) which shows all Boeing designs to scale, it is interesting to see how, up to the early thirties, Boeing concentrated mainly on small single- and two-seaters. Exceptions were the Model 40 and Model 80 transports, and these led to the famous Monomail monoplane which was the fore-runner of the revolutionary YB-9 bomber, Model 247 airliner and the B-17/Stratoliner family.

Since then, Boeing has built only big aircraft, and the chart is dominated by the Superfortresses, Stratocruisers, Stratojets, Stratofortresses, Stratotankers and Jet Stratoliners of the 1940s and 1950s, with the sinister black shape of the IM-99 Bomarc missile pointing to the future.

It is difficult to imagine a time when Boeing was a small struggling company; yet it might well have gone out of existence in 1921 if it had not won a contract to build 200 Thomas Morse MB-3A fighters by quoting a price so low that its competitors expected it to lose money on the deal. Nor did the financial worries disappear then, for an even harder struggle for survival followed the end of World War II, when it seemed that the U.S.A.F. was no longer interested in new bombers, so that work came almost to an end in the company's Seattle factory, which at that time cost half-a-million dollars a day to run in terms of payroll alone.

Unfortunately, the aircraft industry may never enjoy the security of older industries, for fighters and bombers are dying and the market for civil aircraft is restricted. How can it be otherwise when a single large jet-transport costs more than six times as much as a Boeing 314 flying-boat transport of 1937 and sixty times as much as the Boeing 40 transport of ten years earlier, of which a fleet of 25 was designed, built and put into service in six months?

On the military side, it is interesting to read how in 1933 the U.S. Army Air Corps planned a gradual step-up in size and weight of its bombers from 75ft span and 15,000 lb weight, through seven stages to 325ft and 300,000 lb, and beyond. Subsequent designs fitted into this plan until the advent of jet power and, even then, the original concept of the B-52 was a 400 m.p.h. turboprop bomber weighing no less than 480,000 lb. The two prototypes of this aircraft cost, incidentally, $53 million.

No less interesting is the story of the development of the B-47, which began with a straight wing and with six engines mounted in its fuselage, and passed through stages involving use of a complex tricycle undercarriage and wing-tip-mounted turbojets before its present configuration was adopted.

These are facts which interest the technician and enthusiast; but there is something in *Vision* for everyone—even for students of psychology and industrial relations, for this is a story of people as well as aircraft, and a model for all future company historians. J.W.R.T.

OTHER BOOKS RECEIVED

Jet Engine Manual, by E. Mangham and A. Peace. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 10s 6d.

Vitality in Administration, by Herbert Morrison, Basil Smallpeice, Sir Alexander Fleck, Sir Wilfrid Neden, A. D. Bonham-Carter, Major-General G. N. Russell. George Allen and Unwin, Ltd., Ruskin House, 40 Museum Street, London, W.C.1 Price 8s 6d.

Annual Report of the Smithsonian Institution, 1955. United States Government Printing Office, Washington, D.C. Price $4.

First Flights, by Oliver Stewart. Routledge and Kegan Paul, Ltd., Broadway House, 68-74 Carter Lane, London, E.C.4. Price 25s.

Aircraft Hydraulics, Vol. 1: Hydraulic Systems, edited by H. G. Conway. Chapman and Hall, 37 Essex Street, London, W.C.2 Price 35s.

The Specification and Management of Materials in Industry, by C. H. Starr. Thames and Hudson, Ltd., 30 Bloomsbury Street, London, W.C.1. Price 21s.

The Helicopter, by Jacob Shapiro. Frederick Muller, Ltd., Ludgate House, 110 Fleet Street, London, E.C.4. Price 21s.

From the Ground Up, by Sandy A. F. MacDonald. Aviation Service Corporation, Ltd., Port Credit P.O., Ontario, Canada. Price $4.

Post-war International Civil Aviation Policy and the Law of the Air, by H. A. Wassenbergh. Martinus Nijhoff, The Hague, Holland.

An A.B.C. of Aeronautics, by L. L. Beckford. Cassell and Co., Ltd., 37/38 St. Andrew's Hill, London, E.C.4. Price 15s.

Hotels and Restaurants in the British Isles. British Travel and Holidays Association, Queen's House, 64 St. James's Street, London, S.W.1. Price 5s.

Complete and Free, by Eric Williams. Eyre and Spottiswoode (Publishers), Ltd., 15, Bedford Street, Strand, W.C.2. Price 16s.

Realities of Space Travel, edited by L. J. Carter. Putnam and Co., Ltd., 42, Great Russell Street, London, W.C.1. Price 35s.

What's New in Flying?, by Marie Neurath. Max Parrish and Co., Ltd., 55, Queen Anne Street, London, W.1. Price 6s.

African ground staff busily unload and clean Central African Airways' Beaver R.M.A. "Duiker" at Blantyre, the southern terminal of the Nyasaland D.H. Beaver service.

CIVIL AVIATION

BRITANNIAS FOR MEXICO

IT is understood that Aeronaves de Mexico have purchased two Bristol Britannia 302s. These aircraft were originally part of B.O.A.C.'s order for seven Britannias of the 300-series, which were subsequently replaced by a repeat-order for seven 312s. Five of these 300s (305s) went to Northeast; and the two 302s—which are nearly completed at Short's Belfast factory—have since been available for early delivery. If the Aeronaves order is confirmed their Britannias could no doubt be delivered later in the summer.

The Mexican airline hopes to operate a new service from Mexico City to New York in the near future, following the recent agreement between Mexico and the U.S.A. The airline at present operates DC-3s, DC-4s and Convair 340s within Mexico.

AIR TRANSPORT AT OXFORD

THERE was a time when a man could know all there was to know about air transport. There are still a few—the Hildreds and Warners of this world—whose knowledge has not been outstripped, and of whom it may be said that the child has not become father to the man. But they are very few, and air transport today is the industry of the specialist. Parkinson's Law is insidiously at work, and it might be asked whether the industry is breeding men of sufficient breadth and wisdom to be its future leaders.

It was with such thoughts in mind that the Royal Aeronautical Society last year sponsored its first Air Transport Course. This took the form of a series of lectures at Oriel College, Oxford, by specialists in the three main fields of air transport—economics, operation and law—and by visiting specialists in other fields. It was so successful that a second course was arranged, and this took place between March 25 and April 13 last. At its conclusion, Dr. A. M. Ballantyne, director and founder of the course, announced that it is now to be an annual event.

Thirty young executives were sent by airlines and manufacturers, and the course again took place in the scholarly fourteenth-century precincts of Oriel College. The resident lecturers were: Economics, S. F. Wheatcroft, B.Sc.(Econ.); Operation, K. G. Wilkinson, D.I.C., F.R.Ae.S.; and Air Law, A. R. Barrowclough, B.A. Their lectures constituted the basic foundations of the course, and on them was built a superstructure of specialist lectures by such authorities as the following:—

Sir William Hildred, director-general of I.A.T.A.; Sir George Edwards, managing director of Vickers-Armstrongs (Aircraft); Professor Goedhuis, Professor of Air Law at Leyden University; Lord Douglas, chairman of B.E.A. and president of I.A.T.A.; Mr. Bo Björkman, secretary-general of the Air Research Bureau; M. Henri Bouché, French representative on the Council of I.C.A.O.; M. Vladimir de Boursac, secretary, Traffic Conference 2, I.A.T.A., Paris; Mr. T. E. Carter, Civil Air Attaché, U.S. Embassy in London; Professor J. C. Cooper, legal adviser, I.A.T.A., and Professor of Air Law, McGill University, Montreal; Mr. E. J. Dickie, deputy-director of control and navigation, Ministry of Civil Aviation; Mr. J. T. Dyment, chief engineer, Trans-Canada Air Lines; Mr. Garret Fitzgerald, assistant commercial manager (planning), Aer Lingus; Mr. K. Hagerup-Svendsen, vice-president, engineering and research, Scandinavian Airlines System; Professor E. J. Richards, Professor of Aeronautical Engineering, Southampton University; Captain Jacob Schenkman, international civil aviation consultant; Mr. J. B. Scott, chief economics officer, B.O.A.C.; and Mr. A. V. J. Vernieuwe, vice-president, Sabena.

An incidental advantage of the course was the opportunity for students during off-moments (of which some felt there could have been more) to talk shop and to exchange ideas on common problems. The students came from a wide variety of aviation interests, including the following:—

Pakistan International Airlines, Icelandair, B.O.A.C., Armstrong Whitworth Aircraft, Air Ceylon, B.E.A., Central African Airways, Vickers-Armstrongs Aircraft, Malayan Airways, Blackburn and General Aircraft, Shell-Mex and B.P., Hunting-Clan, Bristol Aircraft, T.A.A., Rolls-Royce, Astra Aircraft South Africa, Middle East Airlines, Air-India International, Fairey Aviation, and South African Airways.

NEW S.A.S. MANAGER

WHEN Mr. Henning Throne-Holst became general manager of Scandinavian Airlines System in 1955, he announced that he would accept the post only as a temporary arrangement. On April 13, Scandinavian Airlines System announced that he is to resign on January 1, and that his successor will be Mr. Ake Rusck.

Mr. Rusck is director-general of the Swedish Royal Board of Water Power, and a well-known personality in his present field. An engineer, he has been director-general of the Board since 1948. When asked for his views on the difficult question of Stockholm's new airport, Mr. Rusck declared himself in favour of the Ska-Edeby alternative. He said that in his new post he would be regarded as a Scandinavian rather than as a Swede.

R.A.F. PILOTS FOR THE CORPORATIONS?

BOTH B.O.A.C. and B.E.A. will shortly begin interviewing some of the R.A.F. aircrew who have returned application forms asking to be considered for training as airline pilots. This follows the Corporations' request to the Air Ministry, signalled to all R.A.F. commands nearly two months ago (well before publication of the Defence White Paper), for assistance with aircrew recruiting. Over 100 R.A.F. aircrew below the rank of flight lieutenant sent in their names and B.O.A.C. and B.E.A., after considering them earlier this month, subsequently sent application forms to those they wished to interview.

B.O.A.C. need about 150 pilots during the next two years and B.E.A. can absorb about 40 this year. Both require a Commercial Pilot's Licence and Instrument Rating as minimum qualifications, and most of the pilots would have to train for about three months before qualifying. Pay in B.O.A.C. as a second officer is £809-£925, plus certain route differentials; in B.E.A. the pilots would receive £500 a year under training, then £1,095 as second officers.

This form of recruitment from the R.A.F. applies only to pilots within the 23-27 age-group, and to those with less than three years of their engagement to serve. Each pilot who is offered employment with a Corporation will then have to apply for release.

The first four-Gipsy-engined airliner and the latest—the D.H.86 of Lancashire Aircraft Corporation seen from the company's Heron at Blackpool. This D.H.86 is one of the very few remaining.

CIVIL AVIATION . . .

DR. WARNER RETIRES

AFTER more than eleven years as president of I.C.A.O., Dr. Edward Pearson Warner is now retiring and handing over his office to Walter Binaghi of Argentina.

Dr. Warner was elected president of I.C.A.O. (then P.I.C.A.O.) on August 15, 1945. He immediately resigned from the U.S. Civil Aeronautics Board and broke off his other American connections. He has since been truly an international figure. In the words of M. Henri Bouché, France's representative on the I.C.A.O. Council: "Dr. Warner has contributed to international civil aviation more than any other man could have done in his time and in his place, but I still believe—and this is a tribute—that Dr. Warner was also the only man who could have done even more. He, during those years, would have been capable of leading international civil aviation more rapidly, and more fully, to the superior and collective objectives assigned to it by the Chicago Convention. He overestimated the external resistance, and underestimated his own strength. If he erred in this, it was by too much modesty." M. Bouché added: "I have never met anyone who had such a grasp of all those sciences, techniques and practices that constitute the art of aeronautics."

FARE INCREASES OPPOSED

THE proposed five per cent transatlantic-fare increases may not go into effect on May 1 as I.A.T.A. originally planned, according to Mr. John Brancker (I.A.T.A.'s traffic director) in a Montreal speech on April 15. He was commenting on the U.S. Civil Aeronautics Board's announcement in Washington that it intended to reject the fare-increase proposal submitted to it by U.S. carriers, who had been given fifteen days in which to submit additional evidence. The C.A.B. said that their final decision would be made on April 25, but they indicated "eventual disapproval." The proposals for increases were, they said, based on seating densities and standards of service which C.A.B. had "repeatedly stated" were economically unsound. The rise in fuel and other costs could not be cited as justification.

A NEW TERMINAL FOR MANCHESTER—

OFFICIAL details have now been released by the City of Manchester of plans for a new terminal building at its civic airport. (A model was illustrated in our April 5 issue.) Work has started, and the buildings should be ready for operation by 1960. Estimated cost is more than £2.2 million.

Two piers (*alias* fingers) will accommodate ten aircraft in five stands on either side. One will be for international traffic and the other for domestic traffic. There will be complete separation of passenger flow and baggage flow, the two movements being respectively on the first floor and ground floor. Sightseers will be accommodated on roof terraces and also on the roofs of the piers. The concourse, restaurants and waiting rooms will all provide an unrestricted view of the apron, and the concourse itself will be "of attractive and welcoming appearance, with concessions and all other amenities."

With an eye, no doubt, to the lessons of London Airport—to which Manchester ranks second in importance in Britain—allowance has been made for future expansion "in all directions" to provide for increases of traffic and for handling developments.

—AND FOR PANAM AT NEW YORK

WE reproduce on the opposite page an impression of the revolutionary terminal building now being erected at New York International for just one airline—Pan American. Due for completion by the end of 1958, at a cost of nearly £3m, it will have as its most novel feature an elliptical cantilever roof extending over the aircraft (six of which can be accommodated at a time) to protect passengers from the weather. The arrangement is a neat compromise between the finger-and-gate system and the apron stand system. It is claimed that the building will be able to handle a fully loaded 160-passenger 707 every fifteen minutes.

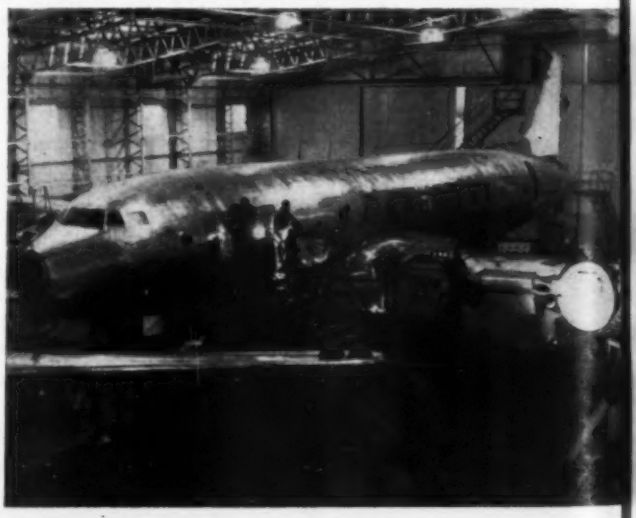
The terminal will be approached by eight traffic lanes, providing six times more vehicle capacity than La Guardia, which handles a dozen airlines. All 48 check-in points will be within 40ft of the entrance, and they will serve all passengers regardless of destination. The passenger lounge will have more than 500 seats, and will be adjacent to all gate positions.

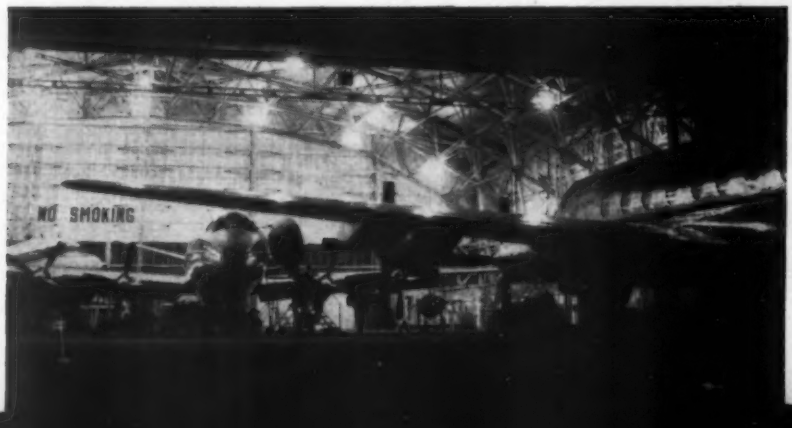
The Prime Minister of Australia, Mr. Menzies, disembarks from a Britannia at Canberra after a recent demonstration flight from Sydney. On board (seen behind Mr. Menzies) was Mr. C. F. Uwins, chairman of Bristol Aircraft.

QANTAS AND ITS 707s

IN the Australian House of Representatives on April 3 members debated Qantas' choice of Boeing 707s, and in particular the Australian Government's wisdom in borrowing $27m for this purpose. Of this sum, $17m will be borrowed from private sources in the United States, the balance being raised from the International Bank.

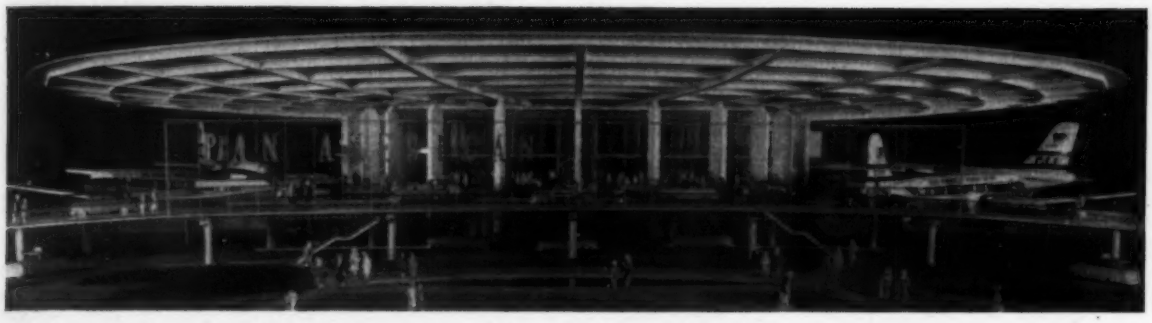
Mr. David Fairbairn asked whether such a loan was justified, and whether comparable aircraft were not available in the sterling area. He failed to see how the loan was going to be repaid, and he argued the merits of the Britannia and Comet. He added "We just had a bill brought down which said in effect 'We want $27m,' with no reason given as to why British aircraft were not available." Australia had a duty to support the British aircraft industry, he said, and Qantas should be directed accordingly.





(Above) Seen undergoing complete renovation at Airwork's Blackbushe base is the company's fifth Hermes. It was one of the last of B.O.A.C.'s fleet to be disposed of.

(Left) Two visiting Viscounts at London Airport enjoying Hunting-Clan's power-plant change, Check B, and "revictualling and valeting" service—a unique 12-hour facility offered at London Airport by this British private-enterprise concern.



An architect's model of the revolutionary New York terminal being constructed for PanAm (see opposite page, col. 1).

Mr. Townley, the Minister, pointed out that Britain herself had just bought American aircraft, and said that Qantas and the Department of Civil Aviation went into the purchase of 707s very carefully, "right down to the most minute details." They did not rely on their own engineers, but discussed the matter with engineers from all over the world and with consultants in three or four countries. "I say that we can accept with equanimity the technical advice which the company gave to the Government."

Reference was made during the debate to "a recent survey" of 58 major airports, only one of which was found able to cope with the American big jets. "It may be," one member said, "that the Minister can tell us that Mascot, with perhaps a little or no expenditure, can be made suitable for these Boeing aeroplanes." If that were so, he said, his opinion was diametrically opposite to that expressed in *Flight* "as late as May 4 last."

BREVITIES

THE Port of New York Authority is to permit the Caravelle to demonstrate at New York from May 2 to May 8, notwithstanding previous bans (on the grounds of noise) on visits by other jet aircraft.

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Aeroflot plans to compete with the SA.S. polar service by operating a Tu-104 service from Copenhagen to Tokyo *via* Moscow and Peking.

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Bristol's new airport at Lulsgate was used for the first time on April 16. It replaces Whitchurch, Bristol's airport for 27 years.

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As we go to press, the strike of Qantas pilots remains unsettled. Two hundred out of 405 flying staff have been dismissed.

Ansett Airlines of Australia have confirmed that they are considering the purchase of Lockheed Electras for delivery in 1959.

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Following the recent Dutch application for rights to operate to the U.S. west coast, a Belgian civil aviation mission will open similar negotiations on behalf of Sabena on July 16.

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Mr. J. A. A. ("Pat") O'Shea, B.E.A.'s assistant overseas sales manager since 1954, is appointed the Corporation's sales manager for Australasia and the Far East.

* * *

K.L.M. is offering 400,630 of its ordinary shares on the U.S. market at 100 guilders each. This is the first time that a national European operator has offered its shares to the public.

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A small spring balance designed to enable airline passengers to check their luggage weights is being made by George Salter and Co., Ltd., of West Bromwich, Birmingham. It is priced at 12s 6d.

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Air transport movements in the United Kingdom during January showed a 19 per cent increase over the figure for the corresponding month of 1956.

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In a lecture given recently at Rotol's Gloucester works, Mr. Somberg of Fokker said that he hoped the Friendship would gain its C. of A. in September 1957.

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Cessna have guaranteed a price of £132,000 for the four-engined 620 executive transport, less radio and other optional equipment. Production is scheduled to start in March 1958, with first deliveries in June of that year.

CLUB AND GLIDING NEWS

ON Saturday, May 11, the Armstrong-Siddeley Flying Club's faithful Tipsy, G-AFSC, officially becomes the club's own property. At a dinner and dance that evening a cheque is to be presented to Basil Meads, secretary of the Kemsley Flying Trust, as last repayment of the Trust's loan which made possible the purchase of the Tipsy some three years ago. Already looking to the future, the club has elected a committee to work out and report back on the pros and cons of a second aircraft and to suggest a type if the answer is an affirmative.

DESPITE petrol rationing, the Scottish Aero Club at Perth managed to do 20 more hours' flying in March than for the corresponding month last year. The landing competition, held on April 6 and 7, was won by Charlie Davidson and recently Messrs. J. Ewart and D. Young have passed P.P.L. tests.

PLANS are going ahead for the Experimental Flying Group camp which is being held near Ipswich between July 20 and July 28. Permission has been obtained to base one or two aircraft at Ipswich Airport, and the organizers, Ian Burn and David Tester, would like to know how many members wish to attend and the number of hours flying they expect to do.

STATISTICS for the eight clubs of the R.A.F. Gliding and Soaring Association in the United Kingdom show that during 1956 they undertook 19,465 launches and 1,815 hours' gliding, including nearly 3,000 miles of cross-country flying. There are about 600 members—of all ranks, from airmen and some airwomen to officers of air rank, mostly non-flying personnel "getting some hours in" in this way—and one of the leading experts is Sgt. Andy Gough, chief flying instructor of the Association's Wessex Club, at Andover. He was awarded the Wakefield Trophy by the B.G.A. for last year's longest flight—one of 199 miles from Andover, Hants, to Grassington in Yorkshire—and since learning to glide in Germany has flown 1,100 hours on gliders.

AT Detling, the Kent Gliding Club reports an increased membership (over 100 flying members compared with 40 originally, and more than 50 associate members) and a total of 4,000 launches up to the end of March. Both the club Prefect and its T.31 have been given C. of A. inspections; the former is having a new Perspex canopy fitted and its instrument panel has been rearranged to include a total-energy variometer. The club is celebrating its first birthday—it was founded on April 27 last year—with a party at the club-house tomorrow evening.

TAPE recordings of lectures and of specimen briefings have been introduced by Derek Piggott, C.F.I. at Lasham Gliding Centre, as a training aid in connection with the instructors' courses now held at Lasham. This idea was first developed by Piggott when he was chief instructor of the R.A.F. Home Command Gliding School at Detling, before joining Lasham in 1953. It is hoped to extend this technique and to build up a library of tapes covering such gliding subjects as thermal and hill soaring, cross-country and cloud flying, which would be available to other clubs.

Three P2V Neptunes of No. 11 (Maritime Reconnaissance) Sqn., at Richmond, N.S.W., after their 30,000 mile round-the-world flight during which they represented the Australian Services during the Ghana independence celebrations at Accra.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Pilot's Day Not Done

IT was "totally untrue" to deduce from the Defence White Paper that with the advent of guided weapons the Royal Air Force would become a "Royal Ground Force" and the pilot's day in the R.A.F. was drawing to a close, said Mr. C. I. Orr-Ewing, Parliamentary Under-Secretary of State for Air, on April 12. Such deductions were untrue for two reasons. First, the manned fighter "has plenty of life left in it. The supersonic English Electric P.1 has not even come into service yet and it will have several years' work to do when it does arrive." Secondly, "people have concentrated on the effect that the surface-to-air guided weapon is going to have on Fighter Command." But Fighter Command "is only one part of the R.A.F. and even when manned aircraft do yield first place to the guided missile in the air defence of the United Kingdom, there will still be many vital jobs in the air which a machine alone simply cannot do. We see a long life still ahead of our growing V-bomber force; and in the vital rôles of transport, maritime support and cold war operations we shall want pilots and plenty of them, for as far into the future as anyone can see."

No. 284 Sqn. Operations

FIGURES lately released showing the activities of No. 284 Sqn. in Cyprus during March indicate the dramatic extent to which R.A.F. helicopters have contributed to recent operations there.

By March 31 the No. 284 Sqn. helicopters, which are based on Nicosia, had flown 441 hours and made 1,111 sorties. 1,489 armed troops, six dogs and 48,820 lb of equipment have been dropped during eight major operations—including the one code-named Whisky Mac, when a terrorist gang was wiped out.

The squadron was formed in Cyprus six months ago and its c.o. is S/L. Peter Fahy.

Standard Presentation

ON Friday, May 24, a Standard is to be presented to No. 216 Squadron by Air Chief Marshal Sir Donald Hardman at R.A.F. Lyneham. The ceremony will take place at 1100 hr and all former members are cordially invited to be present. Those interested should contact the Adjutant, No. 216 Squadron, R.A.F. Lyneham, Wilts (tel. Bradenstoke 271, ext. 261).

Adastral House Memento

A BRONZE plaque has been placed in the wall beside what was once the main entrance to Adastral House, at the south-east corner of Kingsway, London, to commemorate the fact that the building (now known as Television House and occupied by Associated-Rediffusion) was for many years the home of the Air Ministry. The plaque bears the inscription: "This building, which was then known as Adastral House, was occupied by the Air Ministry from 1919 to 1955. During the earlier part of this period it was the main headquarters building of the Royal Air Force."

R.A.F. Appointments

AMONG recent Royal Air Force appointments announced by the Air Ministry are the following:—

G/C. E. G. Sewell, to Air Ministry, for duty in the Department of the Air Member for Personnel; G/C. W. D. G. Watkins, to R.A.F. Boscombe Down, for technical duties; W/C. G. H. Lambert, to H.Q., Fighter Command, for technical staff duties; W/C. G. A. Pearson, to R.A.F. Lindholme, for technical duties.

IN BRIEF

Cadets from No. 470 (Falkirk) Sqn. are again representing the Air Training Corps at this year's Inter-Service Cadet Small-bore shooting competition for the Punch Trophy, to be held today in the Witan Rifle Club, County Hall, London, S.E.1.

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There are vacancies for 640 boy entrants into the R.A.F. next June. Candidates—aged between 15¼ and 16¼ on June 1, though some between 15 and 17 on that date may be accepted—should apply to Air Ministry on an A.M. Form 1391 not later than next Wednesday, May 1.

On April 12 at R.N. Lee-on-Solent Capt. the Hon. V. M. Wyndham-Quin, deputy chairman of the R.N.L.I., presented the Boyd Trophy—premier F.A.A. award—to Lt. R. H. Williams in recognition of 1956's "outstanding feat of Naval aviation," the rescue of the crew of the Norwegian ship "Dovrefjell" by helicopters from the Pentland Firth on Feb. 3. On the same day, a R.N. Whirlwind from Lee flew out to a Swedish ship in the Bay of Biscay and successfully conveyed an injured seaman to Brest. Below, the crew—Lt-Cdr. K. Mitchell (left), Lt. W. Stanley and P.O. Thomas McAllister—back at base after their round trip of 600 miles.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Parliament and the Private Pilot

IN reference to "Ray of Hope for Private Pilots?" in the March 29 issue of *Flight*, page 401, I should like to challenge the figure given for the number of flying clubs by Mr. Airey Neave, in his reply to the debate, as 140 operational clubs. I think that the number of Flying Groups must also have been included in this figure, which is, therefore, misleading. Surely the distinction ought always to be made clear between clubs and groups?

As regards the closing of Croydon next year, how about the possibility of transferring all Croydon's activities to R.A.F. Kenley, if this could be handed over for civil use? This could then be a centre for training, sporting and light commercial flying, and leave Hendon for only commercial transport operators prepared to use the coming generation of S.T.O.L. aircraft.

Bexhill-on-Sea, Sussex. HUGH A. GORDON.

"Mozart and Exports"

FOR some time I have become accustomed to—and, indeed, have learned to love—the masterpieces of trivial comment which form a proportion of the readers' letters which you publish. The corrections, so earnestly pointed out—that the elevator trim-tab on the Scunthorpe-built versions of the 1918 Grandly Sage Z.99 sea-based reconnaissance-transport fighter ("affectionately known, I recall, as the 'Beefbag' by the boys of 'C' Flight . . .") was, in fact, the Mark 4D and not the 4E; and which, indeed, was painted dark grey and not medium grey—are the bread and butter of this world of useless information. It seems that the only reaction to exceptionally good articles has come to be unpleasantly large doses of this sort of quibbling absurdity.

The latest trend, however, as exemplified by the letter from Mr. Julian Snow, M.P., in your issue of April 5, is a far more serious matter. Your leading article in *Flight* of March 15, sir, was the finest piece of writing that has appeared in any aviation magazine for a long time. The letter from Mr. Snow expressing disapproval of this article was the finest piece of pompous protestation to appear in any publication (with the obvious exception of *Hansard*) for a much longer time.

Mr. Snow's thesis appears to be that as there may be some who do not understand a particular piece of good writing, it is preferable for such writing not to appear. This is not only nonsense but is extremely dangerous nonsense. Much of *Flight*'s prestige and authority today is the result of your refusal to pander to the lowest common denominator among your readers.

No, Mr. Snow, if people cannot understand the meaning of an article in *Flight* (or in the *Manchester Guardian*, the *Radio Times*, the *Journal of the Royal Aeronautical Society*, *Pravda*, *Mickey Mouse Weekly*, *Encyclopædia Britannica* or any other publication) they have available two simple courses of action. They can, if they wish, *learn* to understand such articles. If they choose not to make this effort, they can cancel their subscription and content themselves with lesser forms of literature.

It is reassuring to know that, in Mr. Snow's own words, he himself "was able to appreciate what was an erudite piece of writing." The first line of his letter, if a statement of fact, is also heartening ("Members of Parliament of any experience are fully conscious . . ."). Good show, Mr. Snow! But let's not worry quite so much about the finer feelings of the ignorant masses. After all, they can always turn to *Hansard* for their simple amusement. I do.

London, S.W.8. K. TUDOR.

[Our correspondent, we think, misses the real point of Mr. Snow's protest—which was made on behalf of French readers who, by reason of the language barrier, had taken the gentle irony of the leading article literally.—Ed.]

That TV Mast

I NOTED that you recently published the Ministry's comments on my note [*Flight*, March 29] criticizing their support of the siting of the TV mast at St. Hilary, Glam. Since then the decision has been announced to proceed with the erection, but the local pilots, supported by their National Association, have not given up the struggle. A dangerous precedent has been created by the Ministry's decision.

The local and national opposition to the mast has not been based at any time on the strict interpretation of the I.C.A.O. obstruction requirements, as it was felt that the commonsense view only was sufficient to damn the project in the eyes of anyone connected with aviation. If the Ministry is unable to take a commonsense view and must be guided by rigid rules and strict interpretation only, we are likely to be in a sorry plight. The I.C.A.O. obstruction limits should surely be considered against the background of airfield siting problems all over the world and should be regarded as "low limits" below which nothing is acceptable. When an airfield was constructed it was surely not the intention of those who framed the I.C.A.O. regulations that artificial obstructions should be allowed to be erected to lower the safety factor to the lowest common denominator.

The Ministry representative at the inquiry was in a privileged position and not subject to cross-examination, but he did in fact use the argument that Rhoose Airport, not being so badly obstructed in its approaches as, say, Zurich, should by inference be allowed to be developed into that unhappy state artificially—a very negative approach, to say the least.

The Ministry state in their comment that they definitely did not advocate the placing of the mast. I can only let the facts speak for themselves, and in passing I note that the Oxford dictionary gives "Advocacy—support, recommendation (of policy, etc.)."

At the inquiry held at Cardiff the Independent Television Authority and the programme contractors were most insistent in their desire not to proceed with the mast should it represent the slightest danger to aviation. Their avowed aim was merely to obtain a decision from the Ministry one way or the other so that at least they could proceed with this, or if necessary another site; they were justifiably annoyed at the delay. Although they regarded the St. Hilary site as the best one available other than Wenvoe, they made no pleas for its erection in the face of opposition. The aviation interests and local authorities were all unanimously opposed to the mast. The only person who was in favour of the mast siting, and who very definitely argued in favour of it, was the representative of the Ministry of Transport and Civil Aviation.

Cowbridge, Glam. G. A. PERROTT,
Chief Pilot.

All-Through Jet Training

From S/L. F. Holt, A.F.C., R.A.F.(Retd.).

I WOULD like to be allowed to answer Hunting Percival's comments on my further letter published in *Flight* of April 5.

(1) According to *Flight* of March 8, the wastage rate on the Jet Provost is the same as that experienced on propeller aircraft training, approximately 30 per cent. I venture to suggest that the self-same pupils would be eliminated under any system of training. This reinforces my argument that it is more economical to eliminate unsuitable material on the inexpensive propeller trainer.

(2) According to Hunting Percival, expert opinion alleges that previous flying experience constitutes a hindrance to progress on the jet trainer. I cannot accept this opinion, and without in any way wishing to question the ability of the R.A.F. instructors, it takes a great many years to become an expert on any subject—more years than the average R.A.F. instructor spends on the job of instructing.

(3) The suggestion that a third training type is wasteful in spares provisioning, technical training, of manpower, etc., is refreshing because it is the first evidence of any concern in the matter of cost. The *ab initio* training in propeller aircraft could be economically and efficiently done at civil establishments, with a great saving in manpower and £.s.d.

(4) Hunting Percival suggest that I ignore the indisputable fact that 50 hours' flying in the Jet Provost provides a pupil who is infinitely superior in every respect to one who has a similar amount of propeller flying. They seem to ignore the fact that in terms of cost, 50 hours in a Jet Provost is equivalent to at least 250 hours in a simple propeller aircraft.

Herne Bay, Kent. FRANK HOLT.

[We have once again invited Hunting Percival Aircraft to comment, and their reply is below. We cannot, incidentally, undertake to publish any further letters on this subject—Ed.]

(1) Wastage at the advanced training stage is negligible following *ab initio* jet training, whereas it remains high following *ab initio* piston-engine training.

(2) Having no knowledge of S/L. Holt's experience in jet flying instruction we cannot comment on his rejection of R.A.F. expert opinion.

(3) The entire case for all-through jet training is based on its all-round economy, including the far higher standard of pupil product vouched for by both the R.A.F. and the NATO examining teams.

(4) Since 250 hours takes at least five times as many weeks or months to achieve as 50 hours, S/L. Holt appears to have forgotten the cost of providing the necessary training capacity.

Mr. Edmund T. Price, chairman of Solar Aircraft of California, with his wife after arriving at London Airport recently on a visit to this country. Solar, one of the main sub-contractors in the J57 production programme, have licensees in this country, including Bristol Aero-Engines (afterburners), Sugg-Solar (small gas turbines) and Teddington Aircraft Controls (technical collaboration).

THE INDUSTRY

Fatigue-testing Installation at Shorts

FOUR machines lately installed at Short Brothers and Harland, Ltd., Belfast, can complete within twelve months an entire component fatigue-testing programme for a major aircraft project.

The largest, manufactured by Losenhausenwerk AG, of Dusseldorf, is hydraulically operated and can impose a 100-ton load as frequently as ten times a second; the last machine to be installed, an Avery-Schenck unit, is capable of putting a load of up to 20 tons on small jointed specimens.

The installation has already been used by Shorts to test aircraft components ranging from wing-root joints to small fitted bolts. The test-piece is held between jaws (adjustable for components up to about 8ft long) which apply load pulsations of varying capacities. Such loads can be maintained, throughout protracted tests, to within a quarter-ton tolerance. When the machine has warmed up the load drift is negligible, though it may increase slightly if excessive variations of temperature cause changes in oil viscosity and volume. Decreasing load is corrected by the controls, and if the value should vary beyond a pre-determined amount the machine will stop automatically.

To ensure that no vibration reaches nearby installations, the Losenhausenwerk machine is mounted on an independent concrete bed resting on springs. This involved excavating to a depth of 16ft and the use of 420 tons of concrete and 12 tons of steel reinforcement.

Aircraft Cable

A NEW type of aircraft cable known as Tersil, developed by W. T. Henley's Telegraph Works Co., Ltd., 51-53 Hatton Garden, London, E.C.1, is being used for the Bristol Proteus 755 turboprop power units in the Britannia 300. The makers state that Bristol Aero-Engines, Ltd., decided on its use after stringent testing which included prolonged ageing of the cable at high temperatures, followed by immersion in kerosine and ester-base lubricating oil.

Tersil cables have nickel-plated copper conductors and an insulation consisting of silicone rubber, glass and polythene terephthalate. This construction, say Henleys, enables Tersil cable to function continuously in ambient temperatures from −50 deg C or lower to +150 deg C; and the inclusion of silicone rubber gives it fire-resistant characteristics.

Mr. S. G. Marshall, appointed manager of the machine shop at the Belfast works of Short Brothers and Harland, Ltd. He has been concerned, as a project engineer, with Comet and Britannia production.

Mr. T. Gilbertson, M.I.P.E., previously production director of Folland Aircraft, Ltd., who has joined the de Havilland Aircraft Co., Ltd., and been appointed deputy general manager of their Christchurch factory.

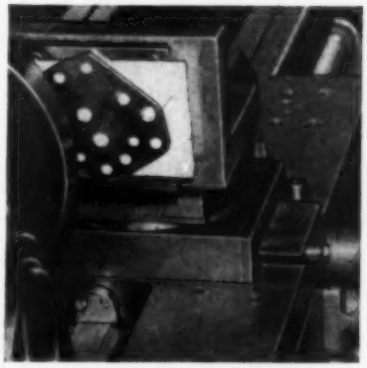
New Microswitches

TO the range of microswitches manufactured by Honeywell-Brown, Ltd., 1 Wadsworth Road, Perivale, Greenford, Middx., have been added a sealed sub-miniature and a low torque rotary switch. The sealed type, listed as 1SE1, contains a basic 11 SM3-T sub-miniature switch embedded with an epoxy resin in an aluminium casting treated to resist corrosion. Developed to meet particular needs in aircraft and electronic applications, the switch is stated to be suitable for operation within a temperature range of −65 deg F to 180 deg F and is electrically rated to 30 volts D.C. for 2.5 amp inductive, and 4 amp resistive, at 50,000ft.

The low-torque rotary switch, listed as V4, is designed for use in mechanisms where very low force is available. A torque as low as 4 gm-in will operate it from a suitable wire actuator which can be shaped as required, and among applications cited are airflow indicators. This V4 switch is for S.P.D.T. operation and is electrically rated for 5 amp at 250 volts A.C. Full details of it are given in a data sheet, HB 46c, available from the manufacturers.

To Facilitate Machining

NEW types of self-adhesive tape developed by Industrial Tapes, Ltd., Speedfix House, 142/146 Old Street, London, E.C.1, are designed for such machine-shop applications as holding small or awkwardly-shaped workpieces on magnetic chucks. This tape is double-sided, and is supplied with an interleaving uncoated strip which is peeled off and discarded. Double-sided Speedfix is manufactured in three different qualities, DSP/1, a light paper tape; DSC/2, a medium-weight cloth tape; and DSC/3, a heavy cloth tape. Whilst the holding strength of all three grades is the same, the varying thicknesses slightly affect accuracy of setting-up. A tolerance quoted for a plate mounted on DSC/2 and ground on both sides is 0.00025in.



Speedfix DSC/2 machining tape in use for a diamond facing operation. The workpiece is a pump component (used in the Viscount) for Rotol and British Messier.

Honeywell Miniature Integrating Gyro

IN the illustration of the Minneapolis-Honeywell miniature integrating gyro which appeared on p. 478 of *Flight* for April 12, the lettered key should have read as follows:—A, baffle plate heater; B, terminal; C, flex lead; D, signal torquer dualsyn; E, heater and sensing element; F, floated gimbal; G, gyro wheel; H, case; I, pivot jewel; J, bellows.

Canadian Helicopter Merger

FROM Malton, Ontario, comes an announcement that Genaire, Ltd., has acquired a majority interest in Rotaire, Ltd., the helicopter repair, overhaul and maintenance company, and that "under the new arrangement Rotaire will cater to the needs of commercial and military helicopter operators in Canada." Day-to-day operations of Rotaire, Ltd., will be under the direction of Mr. Art Limmert, vice-president and managing director, and the new company will be supported by Genaire's facilities at Toronto Airport and at St. Catherine's Municipal Airport. Among reasons for its formation are mentioned "the growing number of smaller operators, the shortage of trained mechanics and air engineers, and the increasing work-loads for commercial and military helicopters."